SCIENTIFIC AMERICAN

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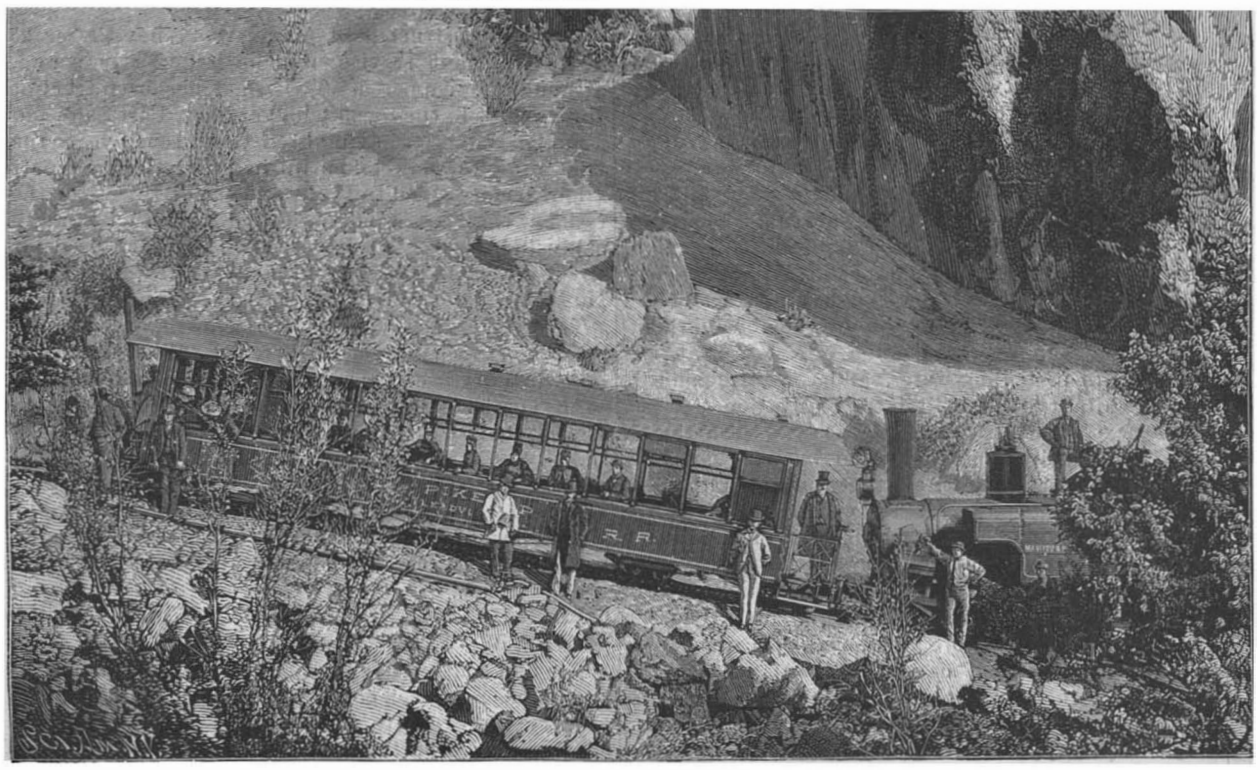


UNDER THE CLIFFS.

THE MANITOU AND PIKE'S PEAK RAILWAY.

BY FRED. R. HASTINGS.

When Zebulon Pike, with his small band of followers, pierced the trackless waste in 1806 and gazed upon the mountain which bears his name, he little dreamed that in future years the ingenuity and enterprise of man would surmount the obstacles of nature, and the same century would see the steel bands of a railway laid up the ascent and a ponderous locomotive hauling its precious load of human freight from the base to the summit.

The Manitou and Pike's Peak Railway is now a reality. The trial trip over the entire line was made October 20 last, and subsequent operation by passenger trains over a large portion of the road has proved the full success of the undertaking. The attempt so successfully carried out to construct a railway up the peak was not the first one. Seven years ago many thousand dollars were sunk in a futile attempt. The plan was to gain the summit by a light grade and smooth rails, which necessitated a much longer route.

Several miles of the grading were completed, when the plan was abandoned.

The roadbed, crossing as it did so many waterways, was continually threatened with washouts. But the failures of the first company have only aided to pilot the present projectors to a wiser course.

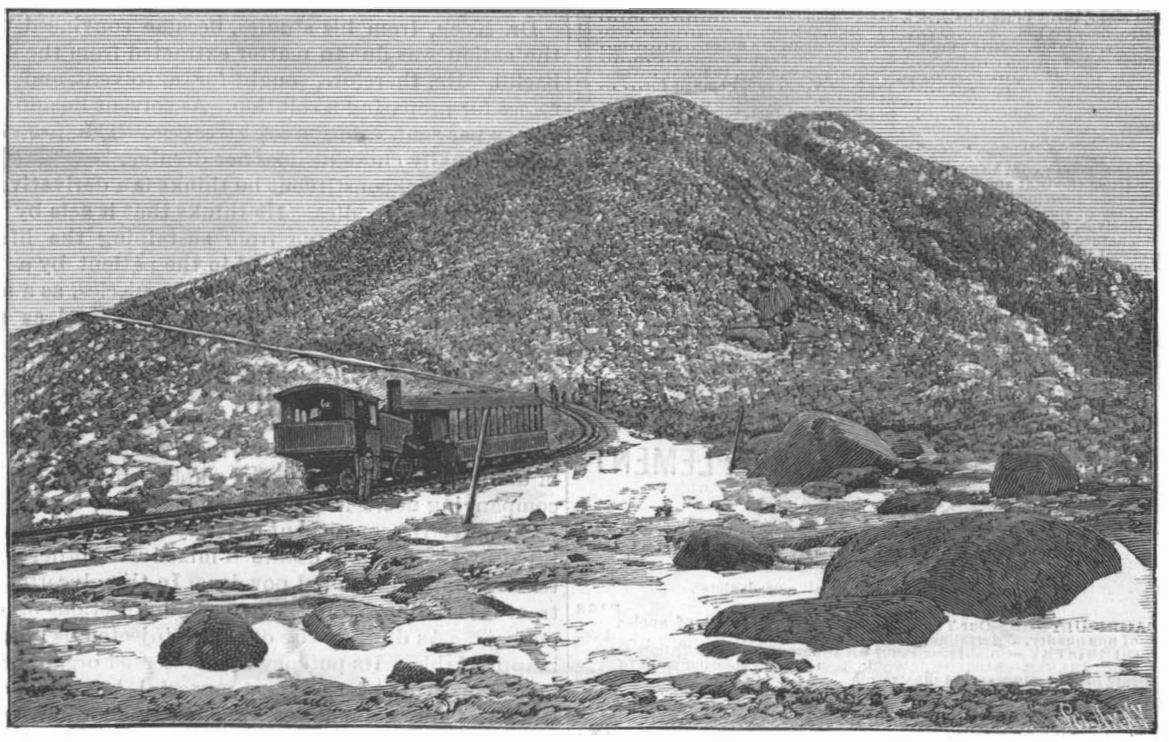
Major John Hulbert, the president of the road, was the first to conceive the proper mode of construction, and he succeeded in interesting a number of railroad officials, whose roads, either by direct or indirect connection, would profit by a line to the summit of the peak. A stock company was soon formed, surveys made, and the contract for the work let.

Mr. T. F. Richardson is the chief engineer of the work, and superintended the entire construction from the time of the first surveys until its completion.

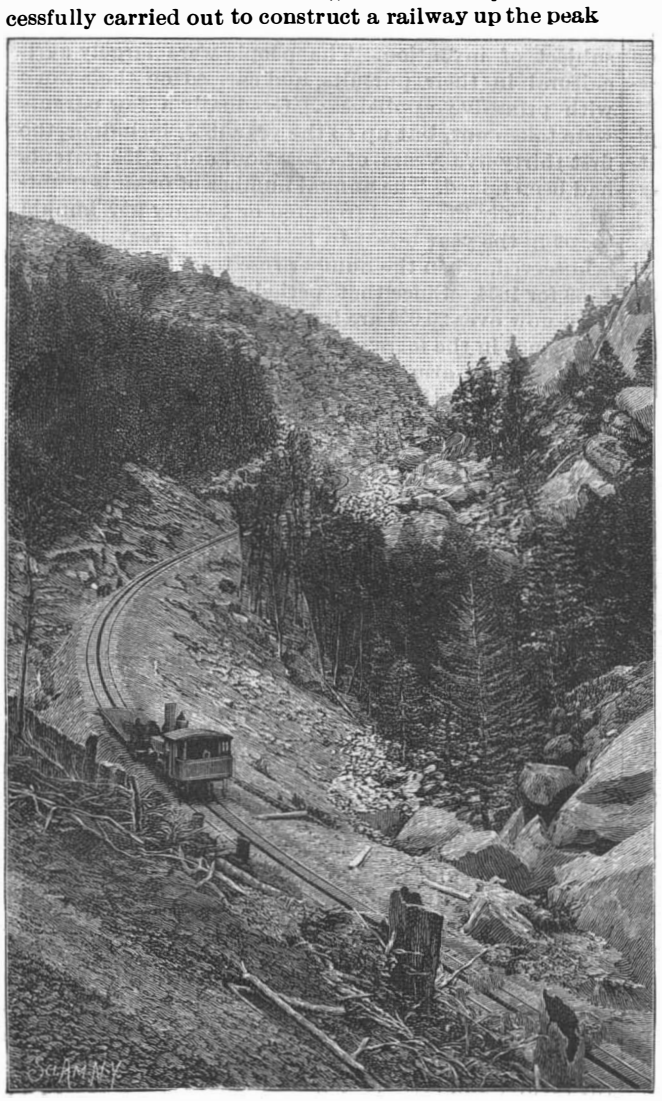
Mr. Z. G. Simmons, of Kenosha, Wis., was the general contractor, with B. Lantry & Sons, of Topeka, Kan., subcontractors for the grading.

The work of construction began September

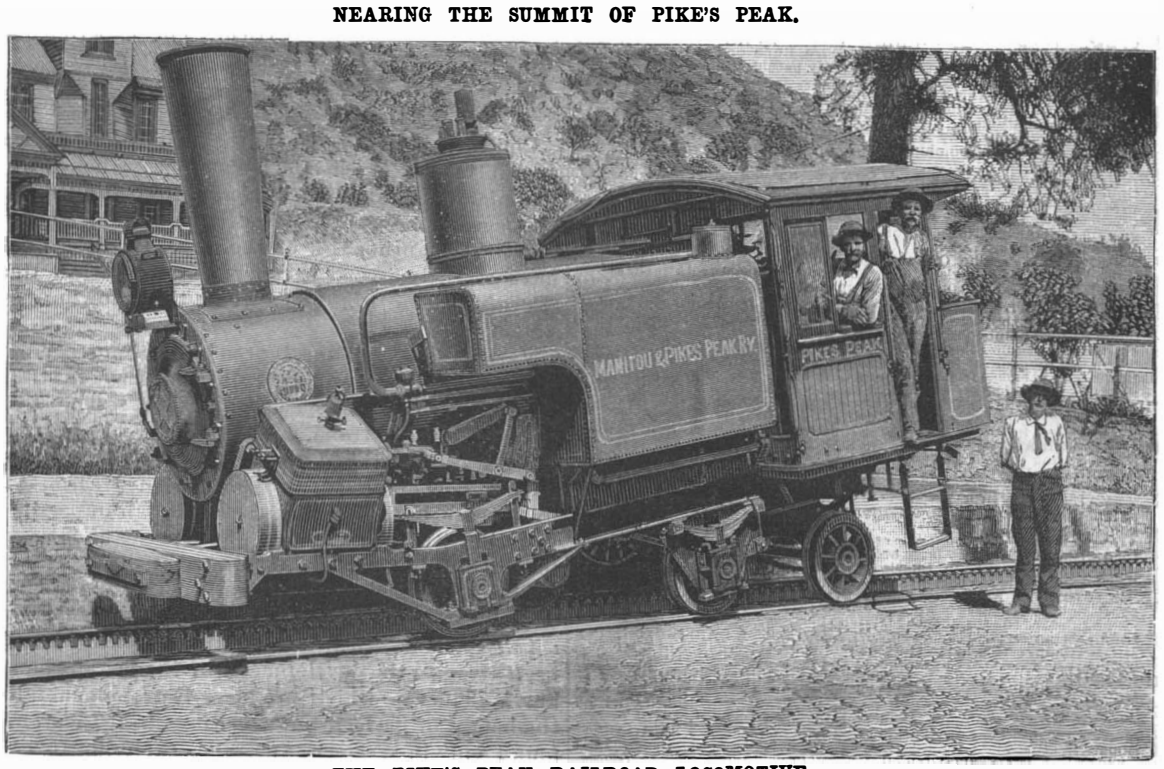
(*Continued on page* 55.)



NEARING THE SUMMIT OF PIKE'S PEAK.



GOING UP A STEEP SECTION.



THE PIKE'S PEAK RAILROAD LOCOMOTIVE.

INCLINED RAILROAD TO THE SUMMIT OF PIKE'S PEAK.

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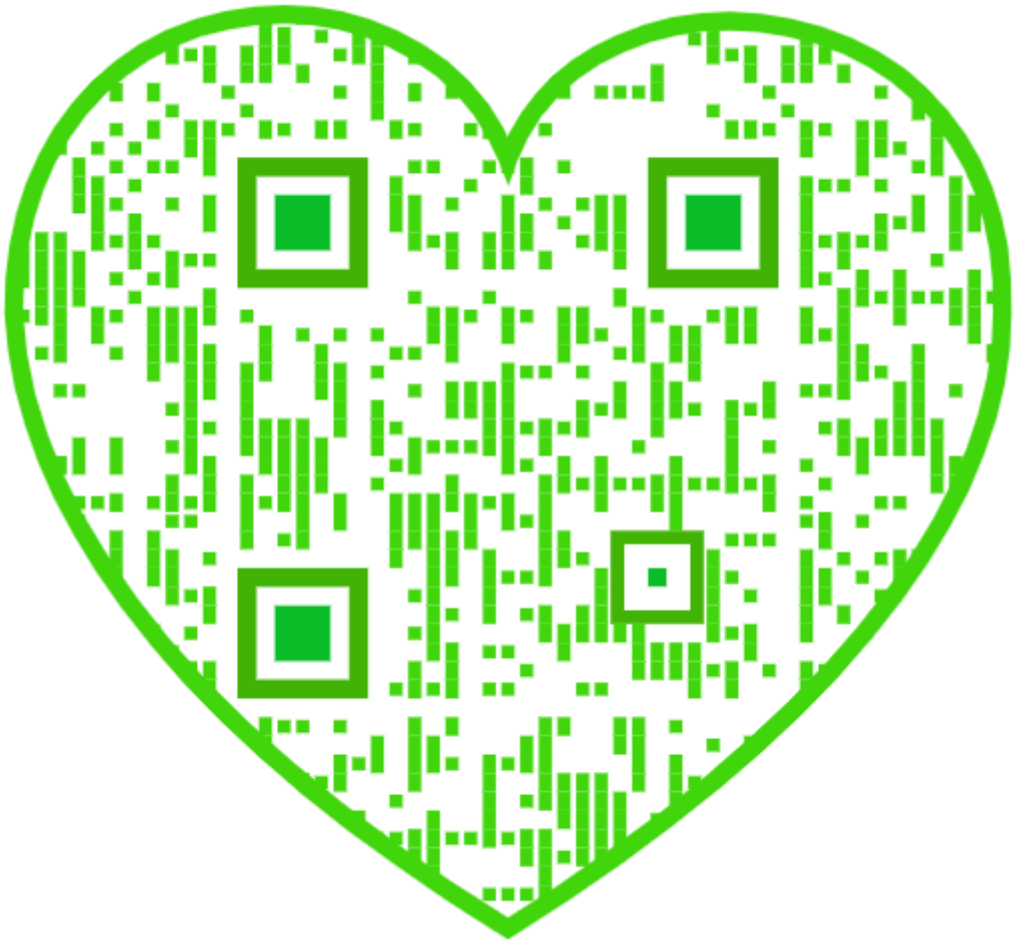

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Contents.

(Illustrated articles are marked with an asterisk.)

Aluminum, soldering..... 53
Ant eater, little, in Berlin*..... 54
Astronomy for 1891 56
Battery, rotating, Sturtevant's... 57
Boiler plates 51
Bronze casting 48
Book patent bill..... 49
Camphor, Florida 54
Crucibles, how made..... 56
Cultivator and cotton chopper, Anderson's*..... 57
Dog owners, warning to..... 51
Electrical copies of the dead.. 53
Electrical rheostat and lamp*.... 51
Electrical sporting bulletins*..... 50
Engines of steamship Mackinaw. 53
Explosives, experiments with.... 53
Gas, natural, Findlay..... 53
Gunboat Concord, trial trip of.... 57
Guns, repeating, tests for..... 49
Heating, steam pipe reqired for.. 54
Inventions recently patented..... 58
Koch lymph, constitution of the.. 48
Lake steamer North Wind*..... 51
Lamp socket and rheostat*..... 51
Locomotive, a mountain railway* 47
Magnetism, new experiments in.. 57
Mechanical Engineering, Sibley College of..... 55
Milk, fat in*..... 51
Miscellaneous notes..... 57
Nails, ingrowing 53
Necktie camera, the..... 49
New York, rapid transit for... ... 49
Notes and queries..... 58
Patent system, second century of 48
Planer, driving gear for, Wellvar's*..... 54
Plants, action of fog on..... 50
Railway, Pike's Peak*..... 47
Sap, flow of 53
Schliemann, death of Dr..... 52
Smuggling in France*..... 50
Sporting bulletins, electrical*..... 50
Steamship North Wind*..... 51
Telephone, was it a?..... 55
Telephony, long distance*..... 51
Tuberculosis, bacillus..... 53
Tunnel schemes in New York.. 52
War ships, position of bridge on. 57
Water power, Sault Ste. Marie.... 48
Wire, steel, the set of..... 54
Wood, jarrah..... 48
Writing test, Prof. Jastrow on.... 53

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 786.

For the Week Ending January 24, 1891.

Price 10 cents. For sale by all newsdealers.

PAGE

I. AGRICULTURE.—Our Twenty "Best" Apples.—A list of apples of fine quality, and available for general culture..... 12506
II. CHEMISTRY.—Solidifying Points of Different Sorts of Tallow.—By FINKENER.—Accurate determination of the melting point of fats in the laboratory.—1 illustration..... 12560
The Changes of Property of Amalgams by Repeated Fusion.—By Dr. G. GORE, F.R.S.—An interesting investigation, applying electricity to the determination of the properties of amalgams.—1 illustration..... 12561
III. CIVIL ENGINEERING.—The Tegel Water Works.—Description with graphic views of the water filtering works supplying the city of Berlin.—6 illustrations..... 12551
Transmission of Power by Flexible Wire Rope or Cable.—By J. E. EMMERSON.—A new wire rope recently patented for the transmission of power.—2 illustrations..... 12554
IV. ELECTRICITY.—New Electrical Boat.—A boat driven by a primary battery, as experimented with in England with surprising results.—2 illustrations..... 12558
Tele-Photography.—By HENRY SUTTON.—Another attempt to transmit a picture by combination of photography and telegraphy.—6 illustrations..... 12559
The Electromagnet.—By Prof. SILVANUS P. THOMPSON.—Continuation of Prof. Thompson's series of lectures, with exhaustive wire gauge and amperage table.—1 illustration..... 12556
Transmitting Pictures Electrically.—By W. S. EATON.—A suggestion for transmitting a picture any distance by electricity.—1 illustration..... 12558
V. ENTOMOLOGY.—The Outlook for Applied Entomology.—Continuation of Prof. Riley's address, treating of insecticide means and processes and bee and silk culture..... 12564
VI. MECHANICAL ENGINEERING.—Friction of Journal Bearings.—A review of the action of lubricants in preventing friction.—Some curious points observed..... 12554
Note on Antique Diamond Drills..... 12561
The Use of Tannins to Prevent Boiler Crust.—By M. LEO VIGNON.—The ill effects of using tannin in boilers.—The question examined by chemical means..... 12561
VII. METEOROLOGY.—The Oschansk Meteorite.—A most interesting discovery of a meteorite, the motion of whose parent meteor was observed in Russia recently.—4 illustrations..... 12563
VIII. MISCELLANEOUS.—Sitting Bull.—Portrait, with notes of the life of Sitting Bull.—1 illustration..... 12562
IX. NATURAL HISTORY.—On the Incubation of Snakes' Eggs.—Elaborate review of the hatching of snakes..... 12563
X. NAVAL ENGINEERING.—Metal Hulls or Wooden Hulls.—A strong presentation of the disadvantages of metal hulls and the good points of wooden hulls for ships..... 12555
Ocean Waves.—A graphic description of what ships have to contend with, and how they have been resisted..... 12551
The U. S. Steamship Charleston.—A view of the new ship Charleston, with short description.—1 illustration..... 12555
XI. PHYSIOLOGY AND HYGIENE.—Myopia.—Curious instance of short-sightedness in captive wild animals..... 12562
The Effect of the Products of High Explosives, Dynamite and Nitro-glycerine, on the Human System.—By THOMAS DARLINGTON, M.D.—The investigation of the troubles incident to the use of high explosives experienced by workmen in quarries and elsewhere..... 12562
XII. TECHNOLOGY.—Process of Disintegrating Fibrous Plants.—By HENRY HARRISON DOTY.—A process applicable to ramie and other fibrous plants described and illustrated.—2 illustrations..... 12560
Retort with Continuous Feed and Discharge.—By R. HAIG.—Mechanical retort for distillation of various materials.—2 illustrations..... 12553
Separation of Finely Divided Mineral or Metallic Matters.—A centrifugal apparatus for effecting the above described result.—1 illustration..... 12560
The Wilde and Reychler Chlorine Process.—New preparation of chlorine gas from magnesium and manganese salts..... 12561

THE CONSTITUTION OF THE KOCH LYMPH DISCLOSED.

The scientific and medical world has been much interested in the announcement by Dr. Koch of the composition of his famous lymph. Conservative as ever in his estimate of its worth, he claims for it distinct value as a reagent for testing the existence of tubercular disease. As a remedy for disease of this nature he attributes to it a proved efficacy, particularly in earlier stages of the disease. He announces also that he proposes to see if his discovery cannot be followed up, so as to lead to analogous treatment for other diseases.

The discovery was based on observation of the effects of injection of pure cultivation of tubercle bacilli upon animals affected with tubercles as well as upon animals in good health. A healthy guinea pig thus inoculated dies. The wound caused by the inoculation closes with a sticky matter, shows signs of healing, but after ten days or two weeks a hard nodule appears, which develops into an ulcerating sore, and death ensues. But if the animal inoculated already has tuberculosis, no nodule forms in the injection wound. It hardens, turns dark, and eventually a piece falls off, leaving a flat ulceration that soon heals. The same result follows the injection of the bacilli cultivation, whether the bacilli are alive or dead. It is the effect probably of a decomposition product or extract of the dead bacilli, but not the life action of the bacilli themselves. A prolonged application of a low heat, the temperature of boiling water, and certain chemicals are alike fatal to the bacilli in the cultivation.

The next point ascertained referred to the action of the dilute cultivation with killed bacilli. This was found to be practically without action on healthy animals, but of very powerful action on those already affected. The tubercular reaction, which has been observed and described so often, was next discovered. The injected tuberculosed animal was killed by a dose that a healthy animal was indifferent to. By great dilution of the fluid before injection, death was avoided and only extended necrosis of the tissue near the place of inoculation was obtained. By extreme dilution the wound produced at the point of injection after a few days' suppuration became covered, and the lymphatic glands became reduced from their swollen condition, and a generally better condition followed.

Dr. Koch, from his studies, became convinced that the action was due to matter extracted from the dead bacilli. He, therefore, sought for a solvent, and processes for preparing a solution. As solvent he adopted a fifty per cent solution of glycerine. The processes he eventually chose he does not divulge.

The essential constituent he thinks is a derivative of the albuminous bodies. He thinks that it acts by unfitting the bodily tissue from sustaining the life of bacilli. The bacilli are killed in the patient by a product of the dead bodies of their own species, as a man might be killed by a cadaveric alkaloid, and as surgeons are killed by blood poisoning from wounds inflicted while dissecting corpses. The death of a patient is due to necrosis of the tissue. This necrotized tissue soon becomes unfit for propagation of the bacillus. By injection with lymph the same condition of unfitness is imparted to the whole body without accompanying necrosis, unless the dose is too large.

The effective constituent of the lymph can be precipitated by alcohol, and obtained mixed with other matter as a white or colored powder. In the glycerine extract it is estimated to be present in fractions of one per cent. As diluted, the quantity injected is almost inappreciable. Its potency upon affected organisms is far beyond that of the most powerful known drugs, when the infinitesimal amounts added, and the intense reaction produced in the system, is considered. As yet no large doses have been tried. The experiments on guinea pigs have proved them to be fatal.

JARRAH WOOD.

Considerable interest in the utilization of woods grown in the English colonies was awakened by the Colonial and Indian Exhibition of 1886, and this interest seems to have been steadily increasing since that date. The authorities of the Royal Gardens at Kew have recently issued a report on the jarrah timber (*Eucalyptus marginata*), of which the following are the salient features:

Various species of encalyptus have been recommended for use in England for outdoor work where strength and durability are specially desired. The freight charges from Australia, where all the species are native, are heavy, and this is one reason why the wood has not been generally introduced. Another reason is that its intense hardness makes it well nigh impossible to work in with English tools. The species of eucalyptus to which most attention was drawn at the Colonial and Indian Exhibition as structural woods was jarrah, *Eucalyptus marginata*, Smith, and the karri, *Eucalyptus diversicolor*, F. Muell. Much more attention has since been given to the development of the jarrah than the karri. The tree which produces it grows generally to the height of 100 feet, but sometimes to 150 feet. It is found only in Western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, advancing to Cape Leeuwin, forming mainly the forests of these tracts. Baron Mueller, in referring to these woods in his "Report on the Forest Resources of Western Australia," says:

"The wood has attained a world-wide celebrity. When especially selected from hilly localities, cut while the sap is least active, and carefully dried, it proves impervious to the borings of the chelura, teredo, and termites. It is extensively in demand for jetties, piles, railway sleepers, fence posts, and all kind of underground structures, and it is equally important as one of the most durable for the planking and frames of ships. It is also much used locally for flooring, rafters, spars, and furniture. It is one of the least inflammable for building structures, and one of the best in Western Australia for charcoal."

Vessels constructed of jarrah wood have, after 25 years constant service remained perfectly sound, although not coppered. The wood has been tried at three places in the Suez Canal, at Suez, Port Said, and Ismailia, and after having been down seven years the trial samples were taken up in order that a report might be forwarded to Paris, and the certificate of the resident engineer pronounced the timber to be practicably indestructible. Jarrah wood has been used for street pavements in Melbourne, Australia, and in the King's Road and Westminster Road in London.

The eucalyptus is of very rapid growth, and the timber, when green, is very easily felled, split, or sawn up, but when dry it becomes very hard. The bark of many of the species abounds in tannin, and has become to some extent an article of commerce. Some of it is said to be twice as strong as oak bark. The bark of some species is remarkable for its hardness; while some throw off their outer bark in longitudinal strips or ribbons, which, hanging down from their stems or branches, present a very singular appearance.

CELEBRATION OF THE BEGINNING OF THE SECOND CENTURY OF THE AMERICAN PATENT SYSTEM.

The first century of existence of the American patent system has now been completed. In the history of the country there are to be found few more important epochs or more worthy of being adequately signalized. The inauguration of the patent laws marks the beginning of a career of unprecedented prosperity among nations. It indicates the fostering by the federal power of the most distinctive feature of the national character. The many inventions, now nearly half a million in number, set forth in the records of the United States Patent Office are a history of mechanical genius and progress of which our country and the world at large should be proud.

It is hard to believe that those who composed and accepted the constitution of the United States, and those who subsequently amended it, could have foreseen the influence which each paragraph would have on the fortunes of so many millions of people. It is definitely certain that the clauses relating to patents could never have been supposed to embody the foundations of the edifice that has been based upon them. In the first days of the republic there was but little interest in the subject of invention. The people were largely agricultural in their pursuits, and carried on their work with primitive appliances. Gradually a few patents were taken out, but up to the year 1825, including the first thirty-five years of operation, only 4,183 patents had been issued. The annual number of patents granted gradually increased from ten or twenty per annum to 299 in the year 1825. In 1854 the first great increase is observed, when the number rose from 846 for 1853 to 1,759 for 1854. Since that period they have increased until now over 20,000 are issued annually.

It is not in the mere granting of letters patent that the fostering arm of the government appears most prominent. Entitled by statute to federal protection by the judiciary, the rights of patentees have formed one of the great subjects of defense by the highest courts of the land. The district and circuit judges are the first appealed to, but from them case after case is brought before the United States Supreme Court at Washington. No subject of personal or even international right can find a higher tribunal for adjudication of its claims than is afforded to the right of the inventor.

The highest judges in the land, and those who have obtained the highest reputation as expounders of the law and as interpreters of the intentions of the legislative bodies, have pronounced strongly and unhesitatingly in favor of the inventor. No class of citizens has been the subject of higher encomium from the bench. Those judges who have been most outspoken in their appreciation of the poorly rewarded efforts of mechanical genius have been those who have attained the highest reputation. Numerous attacks have been made upon the system in Congress, but all have met with the same fate, and have failed at an early stage. To-day the nation at large may be thankful in seeing the statutes undisturbed and intact. It is a guarantee of the future progress of the country. The maintenance of laws so fruitful in good in the past promises well for the future, and is the best insurance of the continuance of inventors' efforts. The more enlightened of our legislators have uniformly opposed on the floor of the

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houses of Congress any impairing of the force and scope of these statutes.

Fortunately we can be said to be entering on this second century under good auspices. The rights of inventors are sustained in the courts and by the houses of Congress. A century of unprecedented work by the inventor now begins. To fittingly celebrate the present epoch, the beginning of the second century of the American patent system, a central executive and advisory committees have been organized at Washington. The *personnel* of the committees includes a long list of names prominent in business and official circles. The Patent Office, United States Senate and House of Representatives, the Smithsonian Institution, the National Museum, United States Geological Survey, the United States Coast and Geodetic Survey, and many other federal bureaus and institutions are represented by their chiefs or other officials.

The centennial of the patent system has passed, because the first patent was granted in 1790. The idea of holding the proposed convention has come a year beyond the proper date for a centennial. It is therefore termed a celebration of the beginning of the second century of the American patent system. The inventor and manufacturer of inventions are appealed to by the committee to hold a fitting celebration in the national capital, to commemorate the entry into the second century of mechanical and scientific progress. They are invited to assist in putting on record the nation's appreciation of the labors of those whose work in the realm of invention has done so much to elevate their country.

It is also suggested that the occasion is a fitting one for organizing a National Association of Inventors, a society for mutual benefit, which it is obvious might accrue in many ways to the members. The committee invite all interested to communicate with their secretary, Mr. J. Elfreth Watkins, U. S. National Museum, Washington, D. C.

THE BOOK PATENT BILL.

The objectionable copyright bill, of which mention was made in our issue of the 10th inst., still lingers in the Senate, and the friends of fair and reasonable legislation hope that it may be either further postponed until next session, or amended so as better to meet the wishes of the public.

A copyright law that shall secure to authors, whether native or foreign, a reasonable reward for their labors, without detriment to the public interests, will be generally welcomed. But a law like that contained in the Senate bill is extremely objectionable, and ought never to be enacted. Among the adverse reasons are the following:

The bill authorizes the assigns of foreign authors to obtain book patents which may be prolonged for the term of 42 years, thus directly encouraging the formation of great book trusts, of the most odious description, whereby the prices of almost any class of books may be greatly advanced, and high prices maintained, without the possibility of competition. This is unfair and disastrous to the public interests.

Bills are now before Congress intended to prevent or discourage the formation of corners and trusts in food products; and similar legislation, with equal reason, should be applied to prevent trusts in intellectual products.

The object of our statesmen should be to encourage and promote the printing of books as much as possible, secure reasonable rewards to authors, and protect them from the grasp of greedy publishers. This might be accomplished by securing the benefits of the copyright to the author and his family. Some such provision as the following might answer this purpose:

"Sec —. No assignment of a copyright by the author shall be valid, but the copyright shall remain vested solely in the author, or in his wife or children if he be dead; and any persons desiring to publish a copyrighted work may do so on payment to the author of a royalty not exceeding ten per cent on the lowest price at which said work is sold by said publisher."

An amendment of this kind would be likely to prove beneficial to the public. It would not seriously interfere with free printing. It would promote rivalry between publishers in their endeavors to supply the people with the best editions at the lowest prices; this everybody wants; it would also secure to authors, native or foreign, a reasonable reward for their labors; and this also would give general satisfaction.

Another objection to the Senate bill is the provision which prolongs the copyright for 42 years—an unreasonable and unnecessary term. It is a relic of the older days when few books were issued, the prices high, and it required years to sell a small edition. In these times of rapid movements in trade and commerce a book term of five years is the equivalent of forty in the old times. Another objection to the Senate bill is the feature which makes it the duty of the Secretary of the Treasury and the Postmaster-General, with their aids and assistants in all parts of the country, to act as the pimps and spies of the assigns of foreign authors. It is made the duty of the above officials to spy out and seize all books going through the mails that infringe the copyrights of foreigners; if an American citizen coming home from abroad brings with him a purchased book on which he has already paid royalty to the author, it is to be seized on landing, unless he can produce the written consent of the man who owns the copyright for this country, signed by two witnesses. Who the said owner may be, in what part of the world he lives, the innocent citizen must find out as best he can, or be despoiled of his property.

Tests for New Repeating Guns.

The government proposes to adopt for army use the best improved magazine guns that can be procured. Inventors will be interested in knowing what are the tests to which they must submit. We give the principal points below. The prize to the successful man will be a great one, being nothing less than the entire supply of the war department with this class of weapons.

The board, of which Col. A. V. Kautz, Eighth Infantry, is president, has drawn up and distributed its programme of tests for the coming competition between the repeating rifles of different makers who may enter the contest.

There are two sets of tests, the first being the preliminary or trial heats, so to say, for the purpose of sifting out those weapons that fail in important particulars, while the finals are for those whose breech action and magazines work effectively in the seven points of excellence required under the initial series of tests.

The first of these seven points is rapidity and accuracy of firing combined. In this there will be three tests in firing from the shoulder at a target six feet by two, placed a hundred yards away. The first has regard to the time of firing and number of hits for twenty shots, the second to the number of shots and hits within the space of two minutes, using the gun as a single loader, the third to the number of shots and hits, using it as a single loader.

The second test is that of rapidity at will, and repeats the conditions of the first test, firing, however, without aim, and from the hip, at short range, and hits or misses do not count, while the two time tests as a single loader and as a magazine gun are only one minute each.

The third is the endurance test, shown by firing 500 continuous rounds with the magazine, examining the breech mechanism at the end of each fifty, and this is to be followed with 100 continuous rounds as a single loader, in both cases, of course, without cleaning.

Then follows the dust test, which is effected in this way:

With the mechanism closed, the piece to be exposed in the box prepared for that purpose to a blast of fine sand dust for two minutes, removed, surplus sand removed by blowing thereon and wiping with the bare hand, and then fired twenty rounds under the following conditions: *a*. Magazine empty when exposed. Before firing load magazine, fire balance of cartridges as a single loader, then those in the magazine. *b*. Magazine loaded when exposed. Remove and wipe cartridges, reload and fire as above.

The fifth test is that of firing with defective cartridges. Three sorts are to be tried. One is to be cross-filed on the head, the second cut at intervals around the rim, and the third cut longitudinally from the rim all the way up. Precautions will be taken to detect any escape of gas in these cases.

Then comes the excessive charge test, in which the gun is fired five times as a single loader with a powder charge producing one-third more chamber pressure than that of the Frankfort cartridge. Finally comes the test of ease of manipulation.

The rifles that pass these tests will then be subject to four others. The first of these is with defective cartridges and dust combined, "the piece to be dusted five minutes, the mechanism being in the mouth of the blowpipe, and closed, but at full cock, then to be fired five shots, the last two defective, then without cleaning to be dusted with the breech open and fired five shots. The piece to be freed from dust only by pounding or wiping with the bare hand." Then the rifle is ready to show what it can do under the exposures of campaign, and for this purpose the rust test is devised. The breech mechanism, receiver, and magazine are cleansed of grease, and the chamber of the barrel greased and plugged, and the breech action closed. Then the butt is inserted to the height of the chamber for ten minutes in a solution of sal ammoniac exposed for two days to the air, and then fired twenty rounds.

But there is still another cause of accidents which must be considered, that of explosions in tubular magazines by jarring. This is to be investigated by giving the rifle a perpendicular jolting for two minutes, first with the magazine charged and then with it half loaded. Finally comes the test of ease and time of taking apart and putting together the breech and magazine systems.

When all this is done, regular firing tests by three men, at 100 yards, will be made; and by that time it surely ought to be possible to tell whether a rifle which has passed through this series of performances is good for anything.

The tests will be made at the Springfield armory, with Frankfort arsenal experimental cartridges of Wetteren smokeless powder imported from Europe. The rifles competing must all be of 0·30 caliber, which is about the minimum of the most successful European magazine arms, that of the new model Lee being 0·303. The board includes three infantry officers, Col. A. V. Kautz, Lieut. Col. R. H. Hall, and Capt. H. B. Freeman; a cavalry officer, Capt. G. S. Anderson; and two ordnance officers, Maj. G. W. McKee and Capt. S. E. Blunt.

Inspector-General Breckenridge in his annual report says that "it is so injurious to an army to know that its arms are obsolete and inferior that the demand for something better than we have now is very earnest. Our citizens, especially the militia, are not satisfied, knowing they must pay with their lives for any lack of preparation when the next war comes." The British have their Lee repeating rifles, the French their Lebel, the Austrians their Mannlicher, in short nearly all the European nations, great and small, have adopted magazine guns, and many of them have smokeless powders giving a high initial velocity and a very long range. Probably no harm has thus far resulted from the failure to supply our army with a weapon of this character, but this is due to the fortunate continuation of peace. No one can question that it is now high time to furnish at least the regular army and portions of the militia with these modern weapons. Probably practical trials by the present board will substantially show what sort of rifle is to be issued to our troops.

Tunnels and Rapid Transit for New York.

The Hudson River tunnel, to January 1, shows a total progress of 2,720 lineal feet out of 5,500 feet under the Hudson River. The progress for some months past has been about 7 feet per day of 24 hours. The shield is reported as working well, and the engineers expect an advance of 10 feet per day under a new system of car loading now being put into operation. By removing the intermediate accumulating pump, and bringing the power of the pump direct to the hydraulic jacks, the pneumatic shield is advanced the width of one of the rings in a few minutes, which before required from two to four hours. A system of chutes is soon to be tried, one under each opening in the shield front, down which the silt will slide direct into the waiting cars, instead of shoveling it by hand as heretofore.

The rapid transit tunnel proposed by Mr. Greathead, the English engineer, for New York, Mr. Simon Sterne tells the *Engineering News*, would cost $1,000,000 per mile for two tunnels with a track in each, or $2,000,000 per mile for four tracks in four parallel tunnels. The first estimate covers stations, rolling stock and a general equipment ready for service. An estimate for a four-track road, 10 miles long, would be $20,000.000 as a maximum; $40,000,000 would build two four-track roads, says Mr. Sterne, which would do infinitely more business than the present elevated roads, which are capitalized at $60,000,000. The time for construction estimated is 2½ years from the Battery to the upper end of Central Park.

A rapid transit scheme for New York, suggested by Mr. David H. King, has colossal proportions, as far as the money required is concerned. Mr. King, however, thinks nothing is expensive that will pay 5 per cent on its bonded indebtedness. He proposes an arched masonry viaduct, 50 feet or more high and 100 feet wide, inside the house line of streets bounding the entire water front of Manhattan Island. For the central line he would acquire a strip 75 feet wide through blocks, and on this build a depressed four or six track road. He would expect to rent the arches for warehouses, and line the depressed road with shops and arcades.

BRONZE CASTING.—According to R. H. Park, of Florence, a sculptor, the art of casting large statues in one piece, as practiced by Benvenuto Cellini in casting the Perseus, which has been a lost art, has been rediscovered. The process is called *cerra perdue;* it is a wax process. The clay model is made, and the plaster reproduction is taken from it. From this the matrix is made, and the matrix is furnished with a core. The matrix is coated with wax the thickness of the bronze. The mould is then heated, and the wax runs out of a hole in the bottom, then the bronze is poured in. The results are superior, but the cost is increased by about $1,000 per statue.

Necktie Camera.

In the first number of the present volume of this paper we described a photographic necktie, by means of which photographs can be taken without the knowledge of the subject. Since the publication of the article we have learned that Mr. L. Manasse, of 88 Madison Street, Chicago, Ill., has obtained the agency of the invention and is prepared to receive orders for the instrument.

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ELECTRICAL SPORTING BULLETINS.

A simple method for the automatic bulletining of electrically transmitted intelligence is a problem long sought for by inventors. Instruments have been proposed, and efforts made to apply them commercially, which, in practice, have been found too complicated for practical purposes, too expensive for general

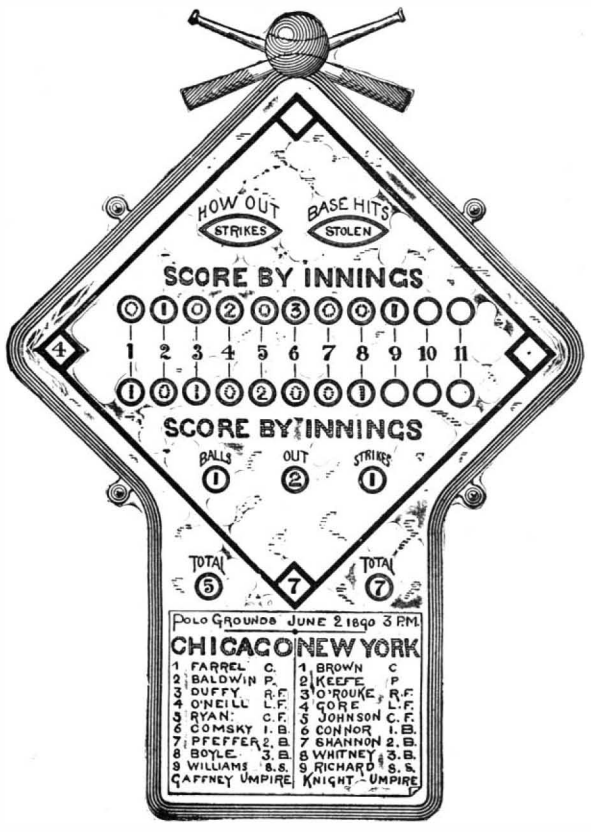


Fig. 1.—ELECTRICAL BASE BALL BULLETIN.

adoption, or, from their fine adjustments and other deficiencies, liable to derange them and error in working. The ideal bulletin or indicator system must be reduced to the simplest electrical and mechanical organization. The electrical formula, so to speak, must be reduced to the lowest terms, approaching, as far as possible, the Morse telegraph. It should be free from complications and delicate adjustments, capable of being relayed and repeated over any length of line within a single circuit. We illustrate a system having these qualities to a marked degree. It is the invention of Mr. S. D. Mott, of Passaic, N. J., who has reduced it to practice in an interesting and popular way by the construction of instruments for the indication of races and national games.

The annexed illustrations show a double bulletin for the popular game of base ball, together with a diagrammatic view of its electrical parts. On the instrument, or in proximity thereto, is a programme of the day's game; the contestants—in this case Chicago and New York—are printed in columns, say red and blue, here indicated in hatched lines, with corresponding colors indicated upon the dial and through the openings in the dial face.

All the details of the game from beginning to end may be indicated, and every feature of play marked upon the board, so that the progress of the game can be watched by any one miles away from the base ball grounds. The plays in base ball follow one another so rapidly that the movable parts of the diagram will be constantly changing, and the interest will be maintained throughout the entire course of the game.

Upon examination, it will be observed that the following points or main features of the game of base ball are as clearly indicated as the clock indicates the time of day: The contestants, time, place, and date of the game, umpire, battery, position of men on field, the inning being played, the side which has the inning, the number of outs in the inning, the man at the bat, the number of strikes called on him, also number of balls called. It shows how the last man went out, whether by fly, fowl, assist, strike, or sacrifice hit, the base run, home run, base on balls, stolen base, or base on error; the table score or the score by innings. A bell taps when any of these changes take place upon the face of the instrument.

The face of the bulletin, as illustrated, shows a game being played at the Polo Grounds, New York, June 2, 1890, at 3 p. m., between Chicago and New York, to stand 7 to 5 in favor of New York. The first half of the 9th inning is being played by Chicago. Ryan and Comisky are out; the latter went out on strikes. Second baseman Pfeffer is to the bat, one strike has been called and one ball; O'Neill is on third base, which he has stolen. The numbers or letters showing through the openings in face of dial are printed on the Bristol board disks held by aluminum spiders fast on shafts bearing a specially devised ratchet, which is actuated by a local electro-magnet energized by a local battery. The disks are shown at $a\ a'$, Fig. 2, and the actuating battery at B, in the same figure. The transmitting battery, B, gives the impulse by sending reversed through the medium of the transmitting keys, $k\ k'$, the local battery, B', doing the work in each instrument, or it may actuate several instruments. The transmitter consists of reversing keys, battery, and operator's guide. The receiver consists of the instrument, A, which controls two separate circuits; one circuit actuates the selector, which selects the local magnet, and the other circuit from the same local battery operates the selected local magnet. The key, k', sends the current over the line, and k through the ground. The latter circuit includes the magnet, m, which actuates the operator's guide, which indicates to him the magnet selected in the instruments under his control.

Fig. 2 shows the contact arms of the selector in circuit with a synchronizing magnet, which, together with all corresponding magnets through the system, is released and progresses one step by a single positive impulse sent over the line.

The diagram is deemed sufficiently clear to need no detailed description.

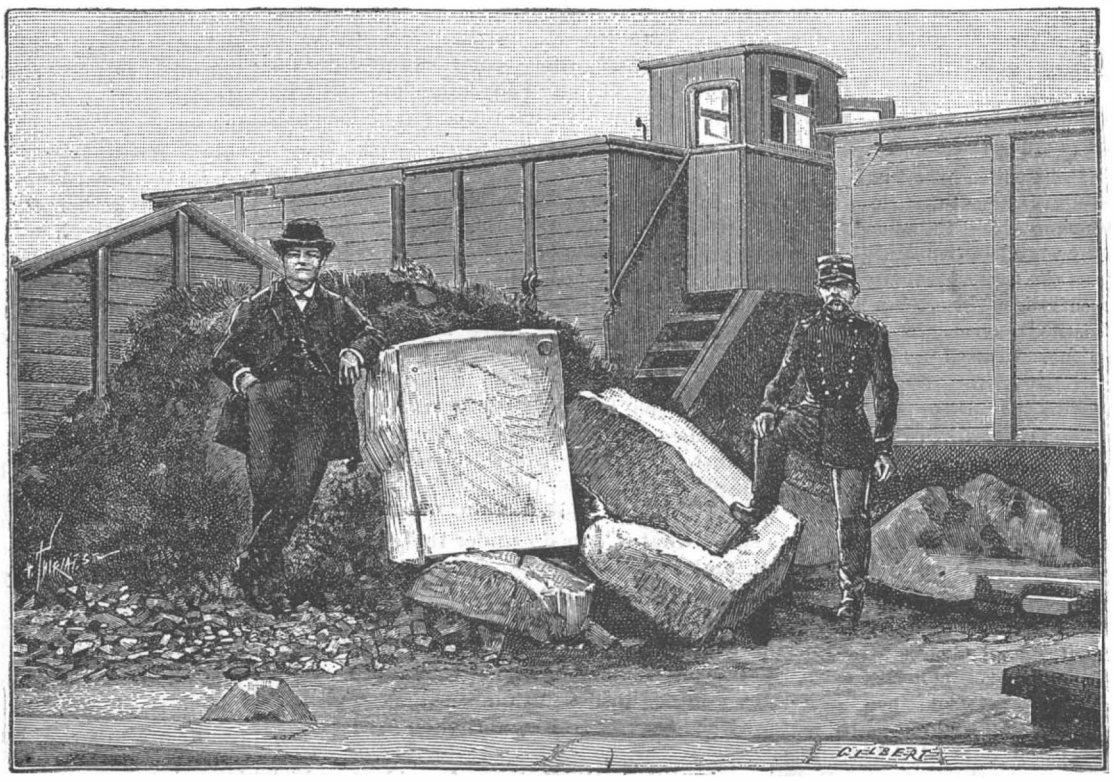
The problem, simply stated, is to enable the operator to select any one magnet out of any reasonable number by a positive or negative impulse sent over the line, and when so selected to cause that magnet to operate by a single reversal.

An important feature of this invention is the novel form of relay or repeater, Fig. 3, devised by Mr. Mott, for this class of work. The method of synchronizing the instruments one with another, as well as the local magnets throughout the system, brings them, at will of the operator, back to the zero or neutral point. The instrument shown in Fig. 3 will operate two separate and independent locals or repeating or relay reversals of polarity.

THE SCIENCE OF SMUGGLING.

With what skill adulterators sometimes utilize the resources of chemistry or physics in order to imitate natural substances or to sophisticate manufactured products is well known. The genius of smugglers knows no less limit. We have recently been apprised of a fact which appears to us to cap the climax. We regret it for the sake of our neighbors across the Rhine, but it is a question of a German fraud.

The following is the fact as communicated to us by Mr. E. Demenge, engineer at Longwy, along with a photograph taken upon the spot as a proof.



A DRESSED STONE SEIZED AND BROKEN AT THE LONGWY CUSTOM HOUSE AND FOUND TO CONTAIN A CAN OF ALCOHOL.

On the 27th of last September the Longwy custom house seized a German car that had started from the Luxemburg station, carrying so-called dressed stone. From one of the blocks there was oozing a liquid that was recognized by the inspector as 96 degree alcohol. The car was put on the wharf and the stone was taken off and broken, when it was observed that the interior, which was hollow, held a zinc box of 1 m. by 0·7 m. by 0·4 m., containing 297 liters of alcohol. The other blocks were found in the same condition. The screw cap was carefully concealed under a layer of cement uniformly marked with the letter D. The numbers succeeded each other, and, upon each stone, there was found another mark indicating the contents in liters.

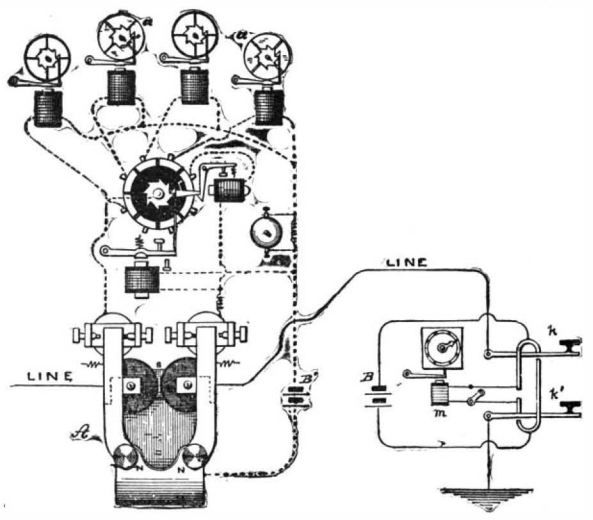


Fig. 2.—DIAGRAM OF MECHANISM AND ELECTRICAL CONNECTIONS OF THE BASE BALL BULLETIN.

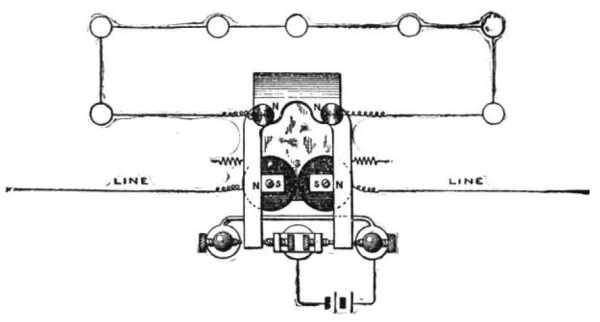


Fig. 3.—PLAN VIEW OF DOUBLE RELAY.

The quantity of alcohol carried by this single car was 2,465 liters. If we reflect that 100 liters of alcohol pay 70 francs customs duty and 156·25 francs excise tax, we find the sum of the taxes that were sought to be evaded to be 4,600 francs for a single shipment. Moreover, these blocks were not making their first trip, but had been used many times before.

The photograph that we reproduce herewith represents one of these stones. Here we see the box with its screw cap in the upper corner to the right, and the pieces of the stone which surrounded the box and which was admirably dressed. The controller of customs is leaning upon the box, while the officer who captured the prize seems to be very proud, and justly so, of the victory gained. The efforts made to cheat the custom house are incessant. The high import duty upon alcohol especially exercises the sagacity of smugglers. According to Mr. Maxime Ducamp, who has studied these questions in his book on Paris, "Cheating is done by means of painted tin plate cabs, which are merely large tanks; and cheating is done by shipping to Paris plates in piles of four dozen. The two dozen of the center conceal a can filled with alcohol; cheating is done with everything and for everything." — *La Nature.*

Action of Fog on Plants.

At a recent meeting of the Royal Botanic Society, the secretary said the action of fogs on plants was most felt by those tropical plants in the society's houses of which the natural habitat was one exposed to sunshine. Plants growing in forests or under tree shade did not so directly feel the want of light; but then, again, a London or town fog not only shaded the plants, but contained smoke, sulphur, and other deleterious agents, which were, perhaps, as deadly to vegetable vitality as absence of light. Soft, tender-leaved plants, and aquatics, such as the *Victoria regia*, suffered more from fog than any class of plants he knew.

TO TAR IRON PIPES.—Coat the outside with coal tar and build a light fire of shavings in the inside. This makes the coating solid. Too much heat melts the tar, so that it runs off the pipe.

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SIMPLE LAMP SOCKET AND RHEOSTAT.

BY GEO. M. HOPKINS.

In the annexed engravings, Fig. 1 represents a simple and efficient electric lamp socket, designed for use in experimental work and in places where an ornamental socket is not required. It consists simply of a small wooden cylinder in which is inserted the end of a brass wire, the projecting portion of which is bent to form a helical coil which fits the thread of the base of an Edison incandescent lamp. In the wooden cylinder is inserted another brass wire of the same size, which is annealed, flattened, and bent over the end of the block as shown, to form the second connection of the lamp.

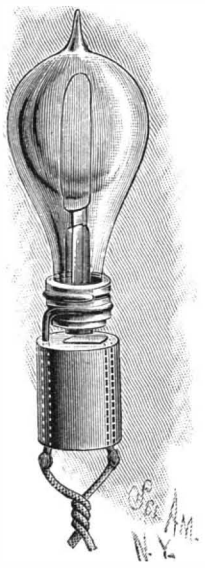


Fig. 1.—SIMPLE LAMP SOCKET.

To the ends of the wires projecting below the wooden cylinder are soldered the ends of the flexible cord which conveys the current to the lamp. By screwing the lamp down in the socket, the button at the bottom is brought into contact with the flattened wire and the circuit is completed. By unscrewing the lamp, the circuit is broken.

A convenient rheostat for experimental purposes is shown in Fig. 2. A number of coiled wire sockets are attached to a board and connected with a wire leading to one of the binding posts at the end of the board. A corresponding number of flat copper strips are secured to the board and soldered to a wire leading to the other binding post. Any one or all of the lamps may be screwed down in their sockets so as to throw them into the circuit. Lamps of any resistance may be used, so that the rheostat can be adapted to the current to be controlled.

With one lamp in the circuit, the resistance thrown in will of course be that of the lamp; with two lamps of the same resistance, half that amount; with three lamps, one-third, and so on, *i. e.*, each lamp thrown in in parallel will increase the conductivity and diminish the resistance of the rheostat.

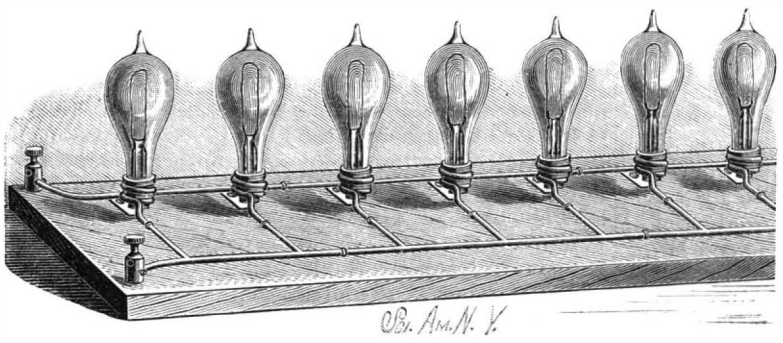


Fig. 2.—RHEOSTAT FORMED OF LAMPS.

It is not essential that all of the lamps should be of the same resistance. When lamps of different resistances are used, their joint conductivity is ascertained by adding the reciprocals of their resistances together. The reciprocal of this equals the joint resistance in ohms. For example take three lamps or combinations of lamps having resistances of 50, 150, and 200 ohms respectively. The reciprocals of these numbers are 1-50, 1-150, and 1-200, the sum of which is 19-600. The reciprocal of this is 600-19; joint resistance of the three lamps in parallel will therefore be 31.6 ohms. Where resistance greater than that of one lamp is required, two or more lamps may be connected in series.

Boiler Plates.

The methods employed by Messrs. Cramp in the building of large modern boilers, with thick plates for high pressures, are thus described:

The plates are, in the first place, pickled in a wooden bath containing a 5 per cent solution of sulphuric or hydrochloric acid. After remaining in the bath for about six hours, they are removed and thoroughly scrubbed with hickory brooms, while a strong stream of fresh water is played upon them. They are then immersed in a bath of lime water to neutralize any remaining acid, and again washed with clean water. All holes are drilled, and the edges of the plates are planed and beveled for calking. The shell plating is bent cold to the proper curvature in the rolls. The flanging is done by a Tweddle hydraulic flanger, the plate being heated to a bright cherry-red. A length of about 8 ft. can be flanged at each heat. Furnace mouth plates are flanged in cast iron dies at a single heat.

After the flanging of tube plates, etc., is completed, they are reheated, and the plates are straightened on a cast iron surface plate, and finally they are annealed by cooling in the open air from a cherry-red heat.

The riveting is performed by a Tweddle hydraulic riveter, using a pressure of 1,500 lb. per square inch on the flange, which gives a stress of about 90 tons on the rivet. The stay tubes are screwed into both tube plates and expanded, the ends in the combustion chamber being beaded over.

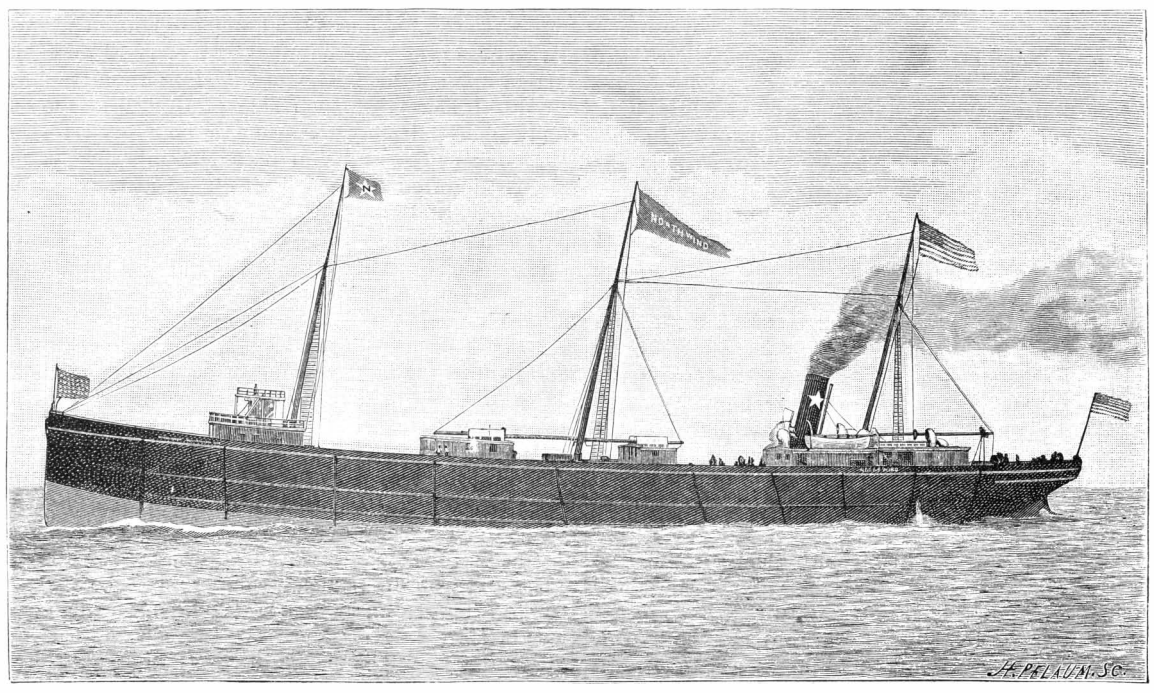
A Warning to Dog Owners.

Possessors of canine pets will do well to take warning from certain recently reported observations of Professor Nothnagel. These go to prove that the development of cysticerci in the human subject is in some cases to be attributed to contact with the saliva of lapdogs which have been allowed to lick the faces and mouths of their owners. The explanation is a feasible one, and adds a noteworthy contribution to our knowledge of morbid etiology. The tænia echinococcus, as is well known, inhabits the small intestine of the dog, and it is highly probable that the ova occasionally find their way into the animal's mouth; for example, in vomiting. There are various æsthetic reasons why the kiss of even the most cleanly and most friendly pug or terrier should be dispensed with. We have now, thanks to the Viennese observer, a still stronger argument to urge against this practice. It may, indeed, like the others, fail to daunt the too-devoted master or mistress, but we cannot do less than avail ourselves of this opportunity to forestall if possible, by a timely warning, the sharper teaching of experience.—*Lancet.*

THE STEAMSHIP NORTH WIND—THE BUSINESS BOAT OF THE LAKES.

The North Wind is one of a fleet of six steel steamships, owned by the Northern Steamship Company, the lake line of the Great Northern Railway Company, between the head of Lake Superior and seaboard connections at Buffalo. As this fleet carried between the opening and close of navigation 500,000 tons of freight, including 1,300,000 barrels of floor, they may well be classed among the money makers, and the immense tonnage credited to them shows the extent of the lake trade outside of the millions of tons in the coal and ore business. But they are unable to meet requirements even in connection with the railway, and preparations are being made for increasing the fleet in the near future by an addition of four steamers, two of which will, in all probability, be passenger steamers, elegantly equipped and so arranged that they can be used for freight traffic when the passenger season is over, carrying 3,500 tons of freight through the Sault canal.

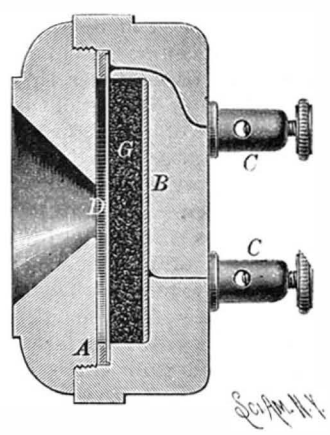
The North Wind, alike to the other boats of this fleet—they are duplicates in every respect and were built by the Globe Iron Works Company—cost her owners $223,000. She is 292 feet keel, 312 feet over all, 40 feet beam and 24½ feet moulded depth. Her triple expansion engines are 24, 38 and 61 by 42, and she has two boilers 14×12½ feet. She has four gangways on either side and six hatches for the handling of freight. A line shaft with two drums to each hatch enables the boat to handle ninety-six barrels of flour at one time, as each of the drums handles eight barrels. The boats are capable of carrying about 2,500 net tons on 15 feet of water through the Sault canal. The boats are thoroughly equipped in every way, the Northern Wave being fitted with an Edison electric light plant, and the entire fleet have Providence windlasses. Electric plants will be placed on all of the other boats of the line during the winter.—*Marine Review.*



NEW LAKE STEAMSHIP THE NORTH WIND.

LONG DISTANCE TELEPHONY.

The difference between the ordinary and the long distance telephone systems lies not so much in the instruments used for transmitting and receiving speech as in the lines. The fundamental thing in the long distance telephone is a metallic circuit, *i. e.*, a line in which the current returns through a wire instead of the ground. Another important difference is that the wire used in the construction of the line is of very high conductivity. By the employment of the metallic circuit the effects of induction are *nil;* the induction in both wires being equal and in opposite directions in the receiving instrument, exactly neutralize each other.



Where the long distance line is in a cable containing other lines, the two wires are usually twisted, to subject them both to exactly the same inductive influence.

These are important points, and it is of course necessary to employ an efficient transmitter. The one commonly used on long distance telephone circuits is known as the "Hunning transmitter," shown in section in annexed engraving, for which we are indebted to Prescott's "Electric Telephone." The diaphragm cell is made of insulating material, and arranged to clamp a diaphragm, D, of thin platinum foil or ferrotype plate, the diaphragm being held in place in the cell by a ring, A. In the cell is arranged a back plate, B, of brass, the space intervening between the back plate, B, and the diaphragm, D, being filled with a body, G, of loose, finely divided conducting material, preferably finely granulated coke, sifted so as to remove all fine dust. Oven-made engine coke is recommended for this purpose. The binding screws, C, C, are placed in connection with the diaphragm, D, and back plate, B.

This transmitter may be used in a circuit with a battery and Bell receiver, or the transmitter and battery may be arranged in circuit with the primary wire of an induction coil, the secondary wire being connected with the line wires extending to a distant point, and there provided with a Bell receiver. This transmitter has been tested by Prof. Cross along with the Edison and Blake transmitters, with the following results: The average strength of the current flowing with the Edison transmitter was 0·100 milliampere; with the Blake transmitter, 0·138 milliampere; and with the Hunning transmitter, 0·560 milliampere.

Fat in Milk.

The Dairy Association of Kiel offers a prize of £150 (3000 marks), for an improved method for determining the fatty matter in new milk, skimmed milk, and butter milk, without the use of a chemical balance as accurately as by the gravimetric process. It must be free from danger, cheap, and so simple in execution as to allow of comparative determinations of the fat in the milk of individual cows; and it must be distinctly preferable to all the methods now in use. Applications marked with a motto and accompanied with a sealed envelope containing the name and address of the sender, and with the apparatus required, may be addressed to Herr C. Boysen, Kiel, up to October 1, 1891.

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New York Tunnel Schemes.

For over twenty years New York City has been the center of tunnel schemes. The first attempt of any importance and upon which any real work was done was the underground road starting at the corner of Broadway and Warren Street, and intended to run under Broadway. This was initiated by and all the work done was after plans designed by A. E. Beach, editor of the SCIENTIFIC AMERICAN. It was in this work that the first use of a shield propelled by hydraulic jacks was practically tested. The shields which have since been used, notably the one employed under the St. Clair River in the tunnel recently completed, and in the Hudson River tunnel, work on which is now progressing favorably, are modifications of this idea, the principle of construction and the method of operation remaining unchanged. It is fair to assume that in this project Mr. Beach was in advance of the times, since although in the construction of 200 or 300 feet of tunnel he demonstrated the feasibility of his plans, the city was not then in such a condition as regarded the uptown distribution of its inhabitants to look favorably upon a scheme of this character. Afterward the completion of the elevated roads was thought to fully solve the problem of transportation of passengers up and down town. Following this there have been many plans for underground railroads in New York, particularly one which proposed to use the entire surface of Broadway, providing for quick and slow traffic by means of four tracks. Numerous other plans have been brought forward, but none has as yet advanced further than paper.

THE HUDSON RIVER TUNNEL.

The next undertaking which advanced further than the drawings was brought foward by Col. D. C. Haskin to tunnel the Hudson River. Work was begun some thirteen years ago, and since then has been carried forward more or less erratically, according to the financial condition of the company. Some months since, English engineers and capitalists, at whose head were Sir Benjamin Baker and Sir John Fowler, took hold of the undertaking, and since their advent the work has been progressing most satisfactorily. The first work here done was of the utmost importance, since it introduced and proved the practicability of running a subaqueous horizontal tunnel through soft material by means of compressed air. The most important fact demonstrated was that the soft silt forming the bed of the Hudson River had sufficient tenacity in itself to act as a wall dividing the air from the water.

The first work done has been so frequently described that it is unnecessary to enter into details. A shaft was first sunk on the New Jersey shore to the depth of about 56 feet below high tide, and from the center of the river wall of this shaft an opening was made, and a temporary tunnel started. The temporary tunnel at the shaft terminated in an air lock similar to those now employed in the bulkheads, and gradually flared in steps so that its longitudinal section was cone shaped until its outer diameter was 22 feet. From the end of the cone or temporary tunnel the two main brick tunnels were begun. Afterward this work was removed and two tunnels continued to the shaft.

In carrying forward the work the heading was formed into steps or terraces in which the men stood, and the excavation was carried on at all points of the face. As fast as the heading advanced, iron plates, one-fourth inch thick and bent to correspond with the curve of the tunnel and flanged upon the four edges, were inserted to form rings, and as soon as a section of 8 or 10 feet had been lined, it was bricked. In this work no attempt whatever was made to protect the silt heading by means of bracing. It was found, as stated above, to be sufficiently tenacious and homogeneous to prevent the escape of air or the entrance of water. The air pressure was kept about equal to the hydrostatic head, and of course was increased as the tunnel advanced under the river. It was a most difficult matter to keep the tunnel to grade, owing to the fact that it was impossible to exactly calculate the amount of settlement that would take place in a section after the masonry work had been completed, slight changes in the density of the silt influencing the amount of settlement, and as this could not be calculated with any degree of certainty, it was impossible to provide for it.

In order, therefore, to keep the tunnel to grade, and as a secondary consideration to ascertain the character of the material in advance of the heading, the so-called pilot tunnel was introduced by John F. Anderson. This pilot tunnel was 6 feet in diameter, and made up of interchangeable plates, flanged so that they could be bolted together, and formed a central hub which extended a few feet into the silt in advance of the face, and also a few feet into the completed masonry of the tunnel. Being supported rigidly at both ends, the central portion of this pilot acted as a foundation upon which struts to support the plates could be placed. It was found that this pilot answered every purpose, and that its use permitted the keeping of the tunnel to the proper line.

THE AIR LOCKS.

Placed at intervals along the tunnel, as the work was completed, were brick bulkheads, in which about a third from the top were inserted air locks 15 feet long, 6 feet in diameter, and provided at each end with a 3 by 4 foot door, of course opening toward the heading. The use of these air locks has been continued until the present time. They are placed about 300 feet apart, the rear one being taken away and advanced as the work advanced. There are now in use three locks, the further one being over 2,000 feet from shore. Any one entering the tunnel passes into the air lock, when the rear door is closed. Air is then admitted, and after the pressure in the lock has become equal to that on the heading side of the lock, the inside door is opened and the visitor passes into the first section of the tunnel, being then under a pressure of about 15 pounds to the square inch. The next lock, at about 1,800 feet from the shaft, is then entered and a slightly increased pressure found in the second section of the work. The third lock is then passed through, and the visitor finds himself in the heading section under a pressure of about 35 pounds to the inch.

THE SHIELD.

If a tube, say 4 inches in diameter and 1 foot long, be made of pasteboard and one end closed with a pasteboard cap and the other end closed with a sheet of tissue paper, it is evident that this cylinder can be submerged in water to any depth, provided a pressure be maintained in the interior equal to the hydrostatic head. In other words, the tissue paper diaphragm, as long as an equilibrium is maintained between the air and water pressure, will serve every purpose of a dividing or separating wall equally as well as the stronger pasteboard diaphragm at the other end. It was this principle which was utilized in the first work of the tunnel. If, now, in place of the tissue paper diaphragm a cap be substituted which is free to move longitudinally over the outside end of the cylinder, and which is about 2 inches in length, a good representation is obtained of the steel shield which is now used in advancing the head. Presuming the joint between this pasteboard cap and the pasteboard cylinder to be airtight, it is evident that the cap can be moved forward or away from the cylinder a short distance without interfering with its duties as a cap.

The steel shield in the tunnel is 20 feet in diameter, 10 feet long, divided in the center by a steel diaphragm, provided with nine openings about 2 feet square. This shield corresponds to the pasteboard cap on the cylinder. It is pushed forward by sixteen 20-ton hydraulic jacks, the cylinders of which are secured in the rim of the shield and the plungers of which find a bearing against the completed work of the tunnel. As the shield is forced forward by the jacks the silt squeezes through each of the nine openings, falls to the bottom of the excavation, is loaded upon a car, run back a short distance, elevated about 12 feet by means of a hydraulic elevator, and then run on tracks up the tunnel, through the locks to the shaft, when it is raised by a second elevator to the surface and carried to the dumping ground.

INSERTING THE PLATES.

After a shield has advanced a space sufficient to permit of the erection of a ring of plates it is stopped and a ring inserted. The ring consists of heavy cast iron flanged plates, 20 inches wide, and varying in weight from 1,100 to 75 pounds, the key plate being the smallest. These plates are handled by means of an erector carried upon a bridge beam traveling upon tracks secured to brackets at each side of the tunnel, so that the beam and its erector arm can be moved forward and back as the occasion may demand. The erector arm is mounted upon a shaft placed at the center of the bridge, and also has, by means of hydraulic cylinders, a motion at right angles to the shaft. It is, therefore, evident that the grasping end of the erector arm can be brought down and made to take hold of the plate lying on the bottom; can then be raised, turned on its shaft so as to bring the plate in position, and to hold it until it has been securely bolted to the ring of plates already in place. It will be seen that this method varies materially from that formerly proposed. In the first place, thin plates were used, which were afterward lined with masonry. In this case heavy cast iron flanged plates are used, which, it is expected, will not be lined except at the bottom, and for a certain distance, probably half way up the sides, the strength of the cast iron plates being calculated to be sufficient to stand the pressure which will come upon them when the air is removed. The work has progressed most satisfactorily, and the heading of the north tunnel is now about 2,400 feet from the shaft on the New Jersey side, or nearly half way across, the whole distance being 5,600 feet. The south tunnel, which of course runs parallel with the northern tunnel, and a few feet from it, is finished for a distance of about 600 feet. At the New York end, instead of sinking a shaft a caisson was sunk, and from the river side of this the two tunnels started. No work has as yet been done on the New York side since the new management took hold, although a shield is now ready to be put in place, and the work is in such condition that it can be resumed at any time. The south tunnel here has been extended about 20 feet and the north tunnel about 180 feet.

PROJECTED EAST RIVER TUNNEL.

Another tunnel scheme which, it seems probable, will be carried through is that by the New York and Long Island Railroad Company, who intend building a tunnel under the East River from Long Island City to New York. All legal difficulties have been overcome and nothing now remains to interfere with the project. The terminus of the tunnel on this side is to be at West Forty-second Street and Tenth Avenue, and at Thompson Avenue, near Dutch Kills, in Long Island City. At the first named point there will be a connection with the freight tracks of the New York Central, and at the other point with the Long Island Railroad. Other branches will probably extend to other points in the city. It is believed, because of the results of borings made along the line of the tunnel, that all the work can be prosecuted in solid rock, and that at all points sufficient head room can be found, so as to do away with the requirement of any masonry work. The length of the tunnel under the river will be nearly half a mile. It is expected that this tunnel, when completed, will do away with the trouble now experienced in crossing the East River, and that other advantages may be looked forward to if the shipping interest at Montauk, the upper end of Long Island, ever develops.—*Iron Age.*

Death of Dr. Henry Schliemann.

Dr. Schliemann was the son of a Lutheran minister. He was born in Aukershagen, Mecklenburg, in 1822. His father was a great student of Greek, and his son early received a strong bent toward the same line of study, and it is said that when a mere boy he determined to discover Troy. After five years of exhausting and distasteful employment with a grocer, which he was forced to engage in from poverty, he got a position as correspondent and bookkeeper with an Amsterdam mercantile house. In 1846 the firm sent him to St. Petersburg as their agent. His business prospered, and he eventually acquired a fortune. He traveled a great deal in the next few years, and learned many modern languages. His knowledge of ancient and modern Greek was thorough.

His archæological work now began. He was the possessor of a fortune. He devoted the rest of his life to investigations among the ruins of Greece and Asia Minor. His first important work on archæology was published in 1869 in French, and was entitled "Ithaque, le Péloponnéss, Troie; Recherche Archæologique." Five years later, in 1874, appeared his "Troy and its Remains," giving the results of his excavations on the site of ancient Troy and the Trojan Plain. He obtained permission in this year from the Greek authorities to prosecute his researches at Mycenæ. Here he made the singularly interesting discovery of five ancient tombs, which he identified as the ones pointed out to Pausanias, the ancient historian of Greece, as those of Agamemnon and his companions, buried by Ægisthus. When it is remembered that these tombs were subjects of local tradition in the days of Pausanias, an idea can be acquired of the insight into the past given by Dr. Schliemann's researches. His discoveries of objects of art in the precious metals were very numerous. A collection of them was exhibited in London in 1877 at the South Kensington museum. He has sold many collections to the different art museums of the world.

His home life was influenced by his classic tastes. His wife was a Grecian, the daughter of an Athenian. Greek was the language of his household, even his servants receiving Greek names. His two children were named respectively Agamemnon and Andromache. In the course of his wanderings he found himself in California when that State was admitted to the Union. He became himself a United States citizen.

Only last year he was commencing new explorations in Asia Minor, under a firman of the Turkish government. His published works were extensive and numerous. His income enabled him to prosecute a work that gave him world-wide fame.

His relations with America were many. It was in the early days of California that he there laid the foundations of his fortune, which he increased during the Crimean war while established in St. Petersburg. His death was announced on December 27. It occurred at Naples, Italy. Few lives have been more fruitful of usefulness.

A CRACK in a piece of metal is prevented from extending further by the well known means of drilling a hole where the rent ends; but when the hole is not bored on just that spot, the crack is apt to continue beyond the hole. To facilitate the search for the exact point, *Revue Industrielle* recommends moistening the cracked surface with petroleum, then wiping it, and immediately rubbing it with chalk. The oil that has penetrated into the crack exudes and thus indicates with precision where the crack stops.

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Correspondence.

Findlay Natural Gas.

To the Editor of the Scientific American:

In your paper of January 3 you quote from Prof. Orton's geological report that the gas in the northwestern Ohio gas fields is "rapidly and surely being exhausted."

I am a citizen of Findlay, which is about central in the field, and know that the population of the city is constantly increasing every year, and that the gas service *was never better or more satisfactory.* It is just now shut off from several factories, not for a lack of gas, but because these factories would not pay an increase in the gas rates which the gas trustees have put upon them. It is not true that the gas is lavishly wasted; but, on the other hand, it is economically and carefully used. F. M. CASE.

Findlay, January 5, 1891.

Bacillus Tuberculosis.

To the Editor of the Scientific American:

I notice in the SCIENTIFIC AMERICAN of January 3, 1891, an error which cannot fail to be misleading. In the illustration, on page 7, of bacillus of tuberculosis the first picture is given as "magnified 900 times," and the second as "magnified 2,000 times." The fact is the first illustration shows the microbe as magnified 900 diameters, and the second 2,000 diameters; the first being enlarged 810,000 times, and the second 4,000,000 times. The only way to demonstrate and identify these microbes is by certain processes of staining, by which the microbe will take a different stain from the surrounding tissue. These stains are produced by preparations of aniline colors, of which several methods are known to bacteriologists. It is needless to remark that these bacteria require the highest powers of the microscope for their exhibition. L. A. WILLSON.

Cleveland, O.

Flow of Sap.

To the Editor of the Scientific American:

I have just noticed in your issue of November 1, 1890, in an article headed "Natural History Notes," a theory that the ascent of the sap in trees is produced by the "vacuum made by the transpiration of the leaves." It occurs to me that one fact has not been taken into consideration in putting forth this theory. If a tree has been cut during the winter, the next spring the sap will flow from the top of the stump as freely as though the tree was still standing. In logs, too, if they have not lain too much in the sun, there will be quite a flowage at the regular time in the spring. This is not a leakage, because the flowage occurs the same, even when the log lies with the small end elevated. There are several other illustrations of the movement of the sap when there are no leaves to operate.

GEO. W. PERRY, *State Geologist.*

Rutland, Vt., Jan. 3, 1891.

Engines of the Steamship Mackinaw.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN of December 27, I notice a description of the steamship Mackinaw, built by F. W. Wheeler & Co., of West Bay City, Mich. West Bay City is about three miles above the mouth of the Saginaw River, and is, therefore, on Lake Huron, not Lake Michigan, as your article states.

My purpose, however, is to give you some further information concerning the engines, which are of my own design. The cylinders are $\frac{21'', 34'', \text{and } 56''}{42''}$ H. P. valve of the piston type, actuated by a Joy gear; I. P. and L. P. valves being flat and driven by Stephenson double bar link gear. The condenser shell is of cast iron, and supports the rear frames which carry the crosshead slides. Over 2,000 square feet of cooling surface is afforded by 988 ¾ inch brass tubes, 11 feet 3 inches in length. The circulating water is supplied by a No. 10 Baldwinsville centrifugal pump driven by an independent engine. The condensed steam is delivered by the air pump to a heater and filter, from which it is taken by the feed pumps and returned to the boilers.

WM. L. MAHON, M.E.

Duluth, Minn., Dec. 29, 1890.

Ingrowing Nails.

To the Editor of the Scientific American:

It is a very remarkable fact that in all the communications that I have read in relation to ingrowing nails, no one has explained why they do grow in.

Some years ago I was much troubled with the big toe nail growing down into the flesh on the side, and had it "lifted" and "stuffed or packed," all to no purpose. At last I came to ask myself, "What makes this nail grow down at this side?" and give the matter what might be called scientific consideration and observation, and I found that the top surface of the nail was thick and hard. I withdrew the packing and went to work scraping, reducing the thickness of the nail so much that, when pressed on, it would indicate that it was quite thin.

Relief was instantaneous, the pressure on the cutting edge of the nail being relieved. In about a week it came up flat or nearly so.

The fact is this—with ingrowing nail, the surface becomes horny, dry, dead-like, and has no grit in it.

A member of my family had a very bad ingrowing toe nail, unable to wear a shoe. The remedy I described was tried, and in ten days was well and wearing her shoe.

The nail must be scraped thin with a sharp knife from the root to the end, and relief will follow sure.

Philadelphia, Pa. A. ROELOSS.

Soldering Aluminum.

A late issue of *Neueste Erfindungen und Erfahrungen* says: The soldering of aluminum is a matter of so great importance that it cannot fail to be of interest to many to know that the Aluminum Company, of Neuhausen, Switzerland, is now offering to the trade a specially prepared aluminum, in sheets, which can readily be soldered with an ordinary soldering iron and tin solder. The line of juncture is prepared by applying a mixture of resin, tallow, and neutral chloride of zinc. Scraping or otherwise cleaning the place to be soldered is to be avoided, although alcohol or turpentine may be used when cleaning is absolutely necessary.

Sheet aluminum may readily be soldered if previously given a light plating with copper. If aluminum so prepared is suddenly heated, there is considerable of the copper stripping off and rendering the joint unreliable. Nevertheless in many cases the process is very satisfactory, and particularly so when the copper plated edges are allowed to lap over each other.

Aluminum bronze containing as much as 5 per cent of aluminum may be readily soft-soldered with ordinary tin solder. Increasing percentages of aluminum render the soldering more and more difficult, until with 10 per cent of aluminum it becomes impossible. The method above referred to, of slightly plating with copper, will be found a help in such cases. When no tank is convenient for dipping the edges into the plating solution, very fair results may be obtained by using a number of pieces of blotting paper well soaked with solution of cupric sulphate. The paper is placed in contact with the article to be plated and with a piece of copper. The battery is then attached by wires with the positive pole to the copper and the negative pole to the casting or other object to be plated. A very short time is sufficient to give a plating heavy enough for soldering purposes. If for any reason a battery is not attainable for plating, the bronze may be prepared with a mixture of resin, tallow, neutral chloride of zinc and corrosive sublimate

Hard-soldering offers no difficulties. A good solder for this purpose is made by smelting together 52 parts copper, 46 parts zinc and 2 parts tin. Borax is used as the flux, and the process is the usual one. Tests of joints made with this solder were made at Neuhausen, and showed that aluminum bronze plates butted together gave a resistance to pulling strain of 26 to 28 kg. per square millimeter; lapped joints (5 mm. lap) required 39 kg. per square millimeter to part them.

Tubes made from sheets with this solder can be drawn down on a mandrel.

Aluminum bronze castings can be united by the process known to foundrymen as sweating or burning. The parts to be joined are placed in a sand mould and an excess of hot metal flowed over the joint. When carefully done the joint cannot be seen, and shows as great strength as the body of the casting. Thin cylinders may be made in this way by bending sheets and sweating their edges together.

Jastrow on a Writing Test.

In a paper entitled "A Study in Mental Statistics," Prof. Jastrow describes the results of a mental test in which fifty students of a class in psychology, at the University of Wisconsin (twenty-five men and twenty-five women), took part. The task consisted in writing 100 words as rapidly as possible. The material thus collected was utilized to shed light upon (1) the similarity of our ideas and habits of thought, (2) the links that bind our ideas together, and (3) the time required for these processes.

1. The general tendency to regard one's mental habits and products as singular and original, and consequently to look upon every evidence of similarity of thought as a strange coincidence, receives a set-back from the result of the present and similar studies, for it is found that these fifty persons, independently writing one hundred words from the many thousand with which they are acquainted, all in all, select from the same 2,024; *i. e.*, of the 5,000 words written, only 2,024 are different. Again, 1,266 words occur but once in the aggregate lists, and omitting these we find that about 3,000 of the words are formed by the repetition of only 758 words. Passing to an analysis of this "mental community," it becomes clear that it is greatest at the beginning of the list, and becomes less toward the end; *i. e.*, the habit is to write first the most common, and when these are exhausted, the more unusual words. A very interesting point is the comparison of men and women in their tendency to repeat one another's thoughts. The evidence is unmistakable that the lists of words drawn up by the women are much more like one another than are those written by the men. The women use only 1,123 different words, the men 1,376. The women write but 520 words that occur but once in the lists, the men write 746 such words.

2. A study of the processes involved in these lists bases itself upon a careful analysis of the ideas therein represented. The relative sizes of such classes, in a measure, indicate the prominence of different classes of objects in the minds of the writers. It may be interesting to mention that the five best represented classes (of the twenty-five adopted in the paper) are "Names of Animals," "Articles of Dress," "Proper Names," "Actions," "Implements and Utensils." The sexes present characteristic preferences for the various classes. The women contribute most largely to "Articles of Dress," writing 224 such words, while the men write but 129. They show an equal favoritism for "Articles of Food," writing 179 such words to but 53 for the men. The men, on the other hand, show fondness for "Implements and Utensils," "Names of Animals," "Professions," "Abstract Terms," etc.

Of the various links by which the one word suggests its successor, it may suffice to indicate as prominent types, (*a*) association by sound, in which words are rhymed, or begin with the same letter; (*b*) by belonging to the same class, as when a series of animals or articles of dress is formed; and (*c*) by more general but not briefly describable relations. One may combine the two inquiries (1) and (2) to ask how often the same word is associated with the same word in different lists. If we take the twenty words most frequently occurring, we find over 500 mentions; and if we examine in each case the word preceding the given word, we find it to be the same in 111 cases, and the succeeding word the same in 145 cases—certainly a remarkable result. Here, again, the women are found to repeat one another more than the men.

3. Regarding the time occupied in the process, the result reached is that (roughly speaking) it takes, on the average, 308 seconds to write such a list of 100 words; that 210 seconds are consumed in the mere act of writing, 114 seconds in thinking of what to write, and 16 seconds in which both may be done.

These results are offered, in addition to whatever value they may possess, as an illustration of how, by simple experimental methods, we may become more intimate with the processes that we constantly but unconsciously perform.—*American Naturalist.*

Experiments with Explosives.

Lieutenant Willoughby Walke, instructor in charge of the United States Artillery School laboratory, has recently made a series of experiments with the object of determining the strength of various explosives. The Quinan pressure gauge used consisted of a heavy block of wood, upon which was bolted a cast iron block. In this block four wrought iron guides were twisted around the circumference of a circle 4 inches in diameter and were connected by a ring at their outer ends; a steel plate was let into the block and was flush with its upper surface. The piston, which rested on a plug of lead, was of tempered steel 4 inches in diameter and 5 inches long, and moved freely between the guides. It weighed 12½ pounds. On the top of this piston was a parabolic cavity to hold the charge of explosive. The shot, made of tempered steel, was 4 inches in diameter and 10 inches long, weighing 4½ pounds. It was bored down its center to receive a capped fuse. To operate the instrument a plug or cylinder of lead was placed on the steel plate and the piston lowered gently down on it. The charge of explosive being placed in the cavity, the shot was gently lowered upon the piston. On firing the charge the shot is thrown out and the piston forced down on the lead plug, which it compresses, the amount of compression being a measure of the strength of the explosive. Twenty-seven explosives in all being tried, the results were compared with those obtained with a sample of nitro-glycerine, the strength of which was reckoned as 100. The results placed explosive gelatine and hellhoffite first with a strength of 106·17. Gun cotton and dynamite had each a strength of over 80; emmensite, a new American explosive, one of nearly 78; bellite, one of 65·70; and melenite, the famous French explosive, which is not nearly so safe to handle as bellite, had a strength of only 50·82.

Electrical Copies of the Dead.

According to *La Nature*, Dr. Variot paints the skin with a concentrated solution of nitrate of silver, and reduces this with vapors of white phosphorus dissolved in sulphide of carbon, the skin being thus rendered dark and shiny. The body is then ready for the electric bath, which is served by a thermo-electric battery, giving a regular adherent deposit of copper if the current is properly regulated. With a layer of one-half to three-fourths mm. the envelope is solid enough to resist pressure or shock. Dr. Variot further incinerates the metallic mummy, leaving holes for the escape of gases. The corpse disappears, and a faithful image or statue remains.

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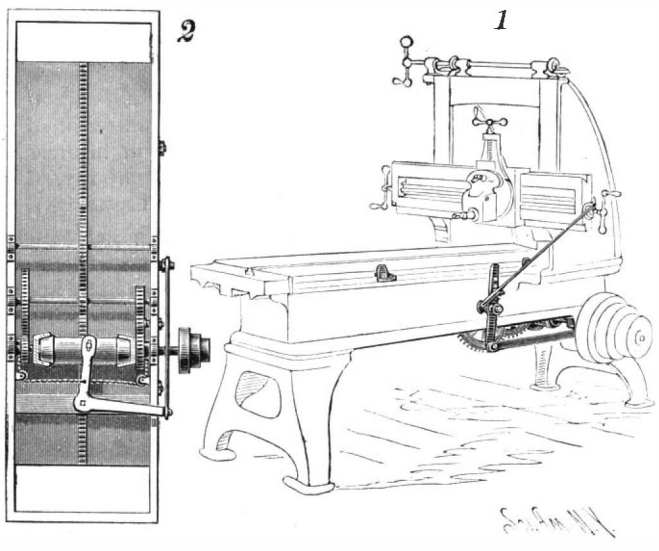
A REVERSING DRIVING GEAR FOR PLANERS.

A driving gear for planers, by means of which the motion of the bed may be quickly reversed without shifting the belts, is shown in the illustration, and has been patented by Mr. George F. Welivar, of Milton, Pa. Fig. 1 shows the improvement applied to a planer, Fig. 2 being an inverted plan view representing the details of the mechanism. On the main driving shaft is the usual cone pulley, and near the other end of the shaft a gear wheel is mounted to turn loosely and to mesh with a gear wheel on a transverse shaft. A pinion centrally secured on the latter shaft meshes into a large gear wheel on another transverse shaft, the latter wheel also meshing in a rack on the under side of the bed. Near the cone pulley end of the driving shaft is another loosely turning gear wheel, which meshes into an intermediate gear wheel, the latter meshing into a wheel on the transverse shaft carrying the central pinion. On the inner face of each of the loosely turning gear wheels is a conical flange, these flanges being adapted for alternate engagement with the conical ends on a clutch which turns and slides on the driving shaft, the clutch having an annular groove engaged by a shifting fork fulcrumed to the bed frame. The fork has an arm pivotally connected by a link with a vertical lever fulcrumed on the side of the bed frame. Adjustable dogs on the bed engage this lever at the end of each stroke, thus shifting the fork to bring the clutch into engagement with the opposite gear wheel, whereby the motion of the bed is reversed at the end of each forward and backward stroke without shifting the belt, which is run continuously on a single pulley. The planer may also be run at different speeds by simply changing the belt on the cone pulley, without any change of pulleys on the line shaft or cutting of belts, while it is designed that the planer shall make a positive stroke capable of planing to a scratch line.



WELIVAR'S DRIVING GEAR FOR PLANERS.

Friction collars on the loose gear wheels are connected by chains with the shifting fork in such manner as to form flexible connections adapted to hold the clutch in engagement with either flange, preventing accidental displacement by the jarring of the machinery or otherwise, and constituting practically automatic tighteners, adapting the clutch for heavy or light work.

THE LITTLE ANT-EATER IN THE ZOOLOGICAL GARDEN AT BERLIN.

The tamandua, or little ant-eater, is one of those animals which, according to the reports of travelers, are very numerous in their native land, but seldom reach Europe alive. This is easily accounted for when we consider the peculiar nature of the food required by the ant-eaters. Many unsuccessful attempts have been made to accustom the larger, plume-tailed members of this family to different food, for it is one of the most attractive creatures in the animal trade, and would bring a high price. But, as the colonist or seaman cannot expect a reward for his trouble, who can blame him for not burdening himself with such an uncertain and unprofitable charge? That may be the reason why this tamandua, which was received here last spring, was the first that I had ever seen alive, and, apparently, the first that had ever lived in a German zoological garden. To be sure, it did not live long, but long enough to give our artist many opportunities for careful studies from life, which resulted in the excellent drawing published in connection herewith.

The little ant-eater, or tamandua (*Myrmecophaga tetradactyla*, L.) is really the medium sized one, for, besides the large ant-bear already mentioned—which is nearly as high as a large dog—there is still another, quite a dwarf, which is little known except by name, even the stuffed specimens being very rarely seen in our museums. The tamandua is about the size of a cat, and differs from the large ant-bear in many respects, a very noticeable difference being the shape of its tail, which is naked at the tip and has the prehensile qualities possessed by many South American apes. The prehensile tail is specially noteworthy, as it indicates a difference in the mode of life within the narrow limits which confine the habits of ant-eaters, the great ant-bear destroying ants and termites—those pests of the tropics—on the ground, while the two smaller species carry on their work in the trees. Let it be mentioned here that the ant-eater, when free, lives less on ants than on termites, which are very different creatures, belonging to a different order of insects. This, perhaps, explains why the ant-eaters in captivity care little for our dry ants and their eggs, preferring gruel and chopped meat with egg. The tamandua is further characterized by the number of its toes, of which there are five on the fore feet and four on the hind feet, being just the reverse of the arrangement of the toes of its larger relative. These large claws serve to destroy the termite nests, and also as powerful weapons in defending themselves against the attacks of dogs and other animals. Many a dog has paid with his life for an indiscreet attack on a large ant-bear, and Hensel states that he has seen one of the smaller ones hold its own against two. The tube-like head and worm-like tongue complete the equipment of the ant-eater. Its color is black and white, but the coloring of the individuals varies considerably, some being almost of a solid color. It has not yet been ascertained whether this has any geographical significance, which does not seem improbable in view of their wide distribution throughout the forests of South America.

THE LITTLE ANT-EATER.

The ant-eaters are edentates, and with the scale-covered animals form the family of Vermilinguia. The similarity of their tongues would seem to indicate a common origin, but this is not possible, as they belong to different lands; the ant-eaters being natives of South America, and the others of Africa and India. They were placed in the same class because they ate the same food, the construction of their tongues making this a necessity, but this classification is no longer accepted. On the other hand, the animals with the worm-like tongue show here and there, in the construction of their bodies, an unmistakable resemblance to the Australian monotremes, which, by the old system, were classed with the edentates, but this classification is not upheld by the discoveries of paleontology, and, therefore, the edentates now living seem to be the scanty and reduced descendants of a widespread and much larger race of animals of past ages, the history of which will remain in darkness until scientific investigations can be undertaken in distant parts of the world.—*Illustrirte Zeitung.*

Steam Pipe Required for Heating.

The question often arises, How much pipe is required to heat a building of a certain cubic capacity? Of course, this varies with the temperature of the steam used, the degree of heat required to be kept up, the frequency with which the doors are opened, the temperature of the outside air, the intensity of the wind, the area of window surface, etc. There are no two places in which the conditions are exactly alike, and it would be hard to lay down an absolute rule for any fixed set of conditions. But there are some good data which will do to start from, and a writer in the *Mechanical News* calculates it as follows:

We may start out with the fact that one unit of heat will raise 55½ cubic feet of air from 62 deg. to 63 deg. F., and can use these figures, no matter what the temperature and the steam are of the building to be warmed, or what outside atmosphere.

For low pressure steam—say about 5 pounds above atmosphere or by the gauge—the length of 4 inch pipe required for heating the air is found by multiplying the volume of air in cubic feet per minute, to be warmed, by the difference of the temperatures in the room and outside, and dividing by 336. The answer will be the length of 4 inch pipe in feet, and will be also about the number of square feet of pipe, as a 4 inch pipe has 12·57 inches circumference, hence but a very trifle over 144 square inches of surface per foot of length. (For 1 inch pipes the divisor required is 84 instead of 336.)

It will take one square foot of direct boiler surface, or its equivalent of floor surface, to keep a temperature of 60 deg. F. in a room with steam at 5 pounds by the gauge, and the ordinary range of temperatures in and out of the room.

The Set of Steel Wire.

Mr. G. Leverich, of the Brooklyn Bridge staff of engineers, was associated with the late Colonel Paine for over twenty years, and relates some interesting reminiscences of his connection with the big structure. When the big sustaining cables for the bridge were being constructed, considerable difficulty was experienced with the coils of steel wire, which, being pretty hard, had a strong tendency to spring back into coil form after being straightened out. This wire in the manufacturing process is reduced to proper size by being drawn through holes in a steel plate. Colonel Paine found that the coiled wire was not so strong by 10 or 15 per cent as if it had been kept straight, and he tried to get the manufacturers and Colonel Roebling to have the defect remedied. One day Colonel Paine drove up to his house in Jersey, and taking a box of coiled wire out of the vehicle stretched it out straight and lo! it remained as it was, without any tendency to coil up again. The colonel had discovered an extremely simple method of accomplishing the desired result, which was, instead of coiling up the wire close to the perforated steel plate after it had been drawn through, and thus make it set, to draw it out some considerable distance before coiling.

Florida Camphor.

According to a paper read by Professor Maisch at the October meeting of the Philadelphia College of Pharmacy, the camphor tree is being cultivated successfully in Florida (*Am. Journ. Pharm*, Nov., p. 565). It seems to flourish in almost any soil, and the tree grows rapidly. It is believed that in ten years time there will be more camphor trees than orange trees in Florida, and that the camphor industry will prove to be more profitable than that of sugar. The camphor obtained from the Florida trees approaches more nearly to that of Japan than to Chinese camphor, since the odor of safrol is distinctly recognizable.

THE work of connecting Paris with London by means of a telephone line is now in progress.

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THE MANITOU AND PIKE'S PEAK RAILWAY.

(*Continued from first page.*)

25, 1889, the grading was completed August 4, 1890, and the track laying October 20, 1890.

When the construction of the roadbed began, eight hundred men and one hundred and fifty horses and mules were put in service.

All provisions, tools, and camping outfits were transported by trail to the various camps along the line on the backs of mules and burros. Only those familiar with the Rocky Mountain region can form an adequate conception of the difficulty of the undertaking. The precipitous cliff of solid granite, the deep canons and ravines, the vast, deep fields of snow, seem obstacles set by Nature never to be surmounted by man.

The road is operated by the Abt cogwheel system. The maximum degree of curvature is 16, or a curve with a radius of 359 feet. The length of the road is a few feet less than nine miles, of which two and three-quarters miles are above timber line. The elevation of the station at Manitou is 6,563·3 feet, the summit of Pike's Peak 14,115·3 feet, the elevation overcome between the points being 7,252 feet. The roadbed is 15 feet wide, increased to 20 and 22 feet through cuts, thus giving protection, in case of derailment, from more serious accident.

No trestle work is used on the entire line. All bridges are built of iron, and were constructed by the Edgemoor Bridge Works, of Wilmington, Del.

The culverts are built of solid masonry and placed wherever necessary to guard against washouts.

The road is standard gauge. The T-rails weigh 40 pounds per yard, and are laid on red spruce ties, 9 feet long. The rack-rail is laid in the center between the T-rails, and consists of two continuous rails made up of parallel bars, each 80 inches long, of soft Bessemer steel, held in position by means of die-forged steel chairs, which are secured to the ties by wood screws. The parallel bars are set 1⅝ inches apart, each containing seventeen teeth or cogs in their length, in which the pinions of the engines interlock 1¼ inches (Fig. 1).

The bars vary in thickness from ⅞ inch to 1¼ inches, or from 21 to 31½ pounds per foot, the heavier bars being used on the steeper grades. The chairs are set 40 inches apart, each bar being doubly bolted to three chairs, in the middle and at either end. The bolt holes in the middle of the bars are of the same size as the bolts, while those at either end are drilled three-eightieths inch larger, to allow for expansion of the bars.

On account of the steepness of the grade and consequent tendency of the track to slide, both by its own constant weight as well as that of passing trains, also from expansion and contraction due to varying temperature, a very thorough system of anchorage has been carried out.

In the entire length of the road 146 anchors are used, varying in distance one from another from 200 to 600 feet, according to the steepness of the grade, and are of two kinds.

In some instances (Fig. 1) a pair of steel straps are secured to one of the chairs, brought forward as a clevis, and attached by means of a coupling adjustable in length to a turned pin, 2½ inches in diameter and 2 feet long, which is leaded into the solid rock.

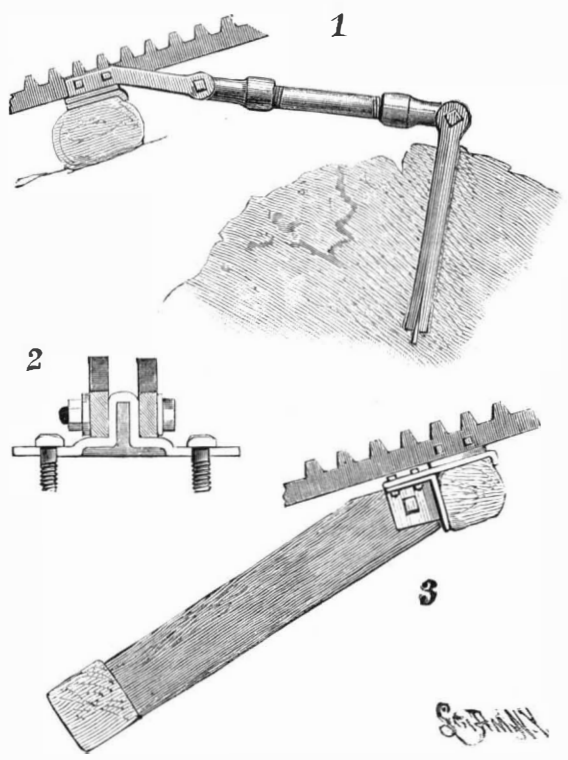
In the absence of a ledge of rock, a steel bar (Fig. 3) is set at the lower side of a tie, and from this an oak timber of cross section 10 inches by 10 inches, and from 10 to 14 feet long, is carried downward at a steeper angle than the grade of the road, and thrusts either against a heavy oak timber embedded in the ballast at right angles to the first timber or against rock. The arrangement of the cogs is shown in Fig. 2.

The engines, three in number, were built by the Baldwin Locomotive Works, of Philadelphia, and present a very different appearance from the ordinary locomotive. Each engine weighs 26 tons, and is capable of carrying two coaches. There is no tender, the water being carried in two saddle tanks of a capacity of 600 gallons on either side of the engine, while a box at the rear carries 1¼ tons of coal, sufficient for one round trip. There are three water stations on the route, besides the one at the lower station.

The cylinders of the engine are 17 inches by 20 inches. The boiler has a 42 inch shell, and the flues are 7 feet long.

The engines have 200 horse power, and are built to stand level on a 16 per cent grade. There are three sets of double pinion brakes on each engine.

The power is transmitted by a main drum, which has teeth similar to the pinions, and works on the two back sets of pinions, the forward set of pinions being driven by rod connection with the middle set. The two back



METHOD OF ANCHORING THE TRACK.

sets, which are connected with the main drum, furnish most of the power for ascending, the forward set of pinions being principally to apply brake power.

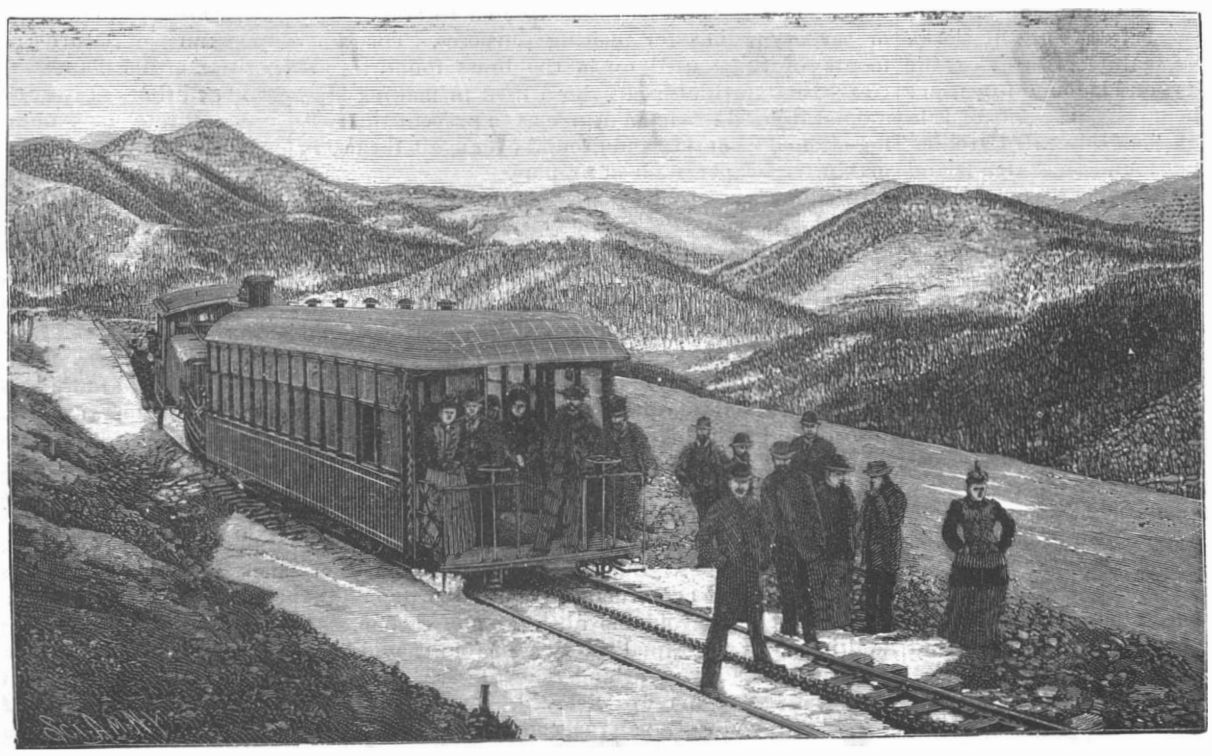
In descending, the cylinders of the engine are used as air compressors, a stream of water being kept running into them continually to keep them from heating. By controlling this compressed air, the speed of the train is regulated.

In addition, the two front sets of pinions have a peculiar steam brake connection which locks them instantly. The back pinion has a hand brake connection which is capable of stopping the whole train in a few seconds time on heaviest grade. Each car has two axles, each of which carries a pinion brake worked by hand from either end of the car, either one of which is capable of holding the whole train.

A brakeman is stationed at each brake during the operation.

The cars, built by the Mason Manufacturing Works, of Springfield, Mass., are 43 feet long, 8½ feet wide, and have a seating capacity of fifty people.

The floors of the cars are 24 inches above the top of the rails. The sides and ends of the cars are of glass as far as possible, so as to give free observation without. The woodwork within is handsomely finished, and the upholstering of old gold plush. The seats are designed to set level on the average grade of 16 per cent. The cars are pushed, not drawn, by the engines, and are not coupled to the engine, but have simply buffers to keep them apart. The car platforms have gates, which are locked while the train is in motion.



PIKE'S PEAK RAILWAY—THE RUN DOWN FROM WINDY POINT.

The trip from Manitou to the summit occupies an hour and forty-five minutes. The trip down will take half an hour less time. The minimum speed of the train is three miles per hour, and the maximum eight miles.

The expense of constructing the entire road was about half a million of dollars.

The company have ceased to operate regular trains for the winter. During the few weeks of the fall when regular trains were run as far as the Half Way House, many people were carried over the line. The road will be open for the summer season about June 1 this year.

Our illustrations are from photographs kindly furnished by Mr. Geo. E. Mellin.

Was It a Telephone?

In Porter's "Knights of Malta," vol. i., chap. xiv., we read: "Shafts were sunk in various directions and galleries driven forward beneath the principal bastions. Martinigo had, however, foreseen the probability of this mode of approach, and the counter mines which he had prepared before the commencement of the siege materially assisted him in opposing them. By the simple aid of the distended parchment of a drum head he was enabled to detect the vicinity of the enemy's miners when at work, through the vibrations of the earth, and his measures were taken accordingly to destroy their advance." Two galleries, however, which had been driven beneath the bastion of England eluded his vigilance, and two fearful explosions ensued.

This event was in 1522, at Rhodes, when besieged by the Turks.

B. V. F.—The principle of the acoustic telephone is no doubt very old. It was one of the peculiar traits of our *beloved* aborigines to listen with their ears to the ground to the movements of their enemies or of animals. They could hear the tread of a horse at a great distance. This was one of the surprises to the early settlers of this country. It is in common practice in mines, and many practice it by telling the approach of trains at many miles by placing the ear upon a rail.

The possibilities of telephonic information, as embodied in the acoustic telephone of the present day, were only an outcome of the application of the ear to the wall, and were probably intensified by the use of a stick of lance wood thrust into the ground in the counter mine and a drum head laid against the end of the stick, with the ear behind the drum head.—ED.

Sibley College of Mechanical Engineering.

The number of students registered this year in Sibley College of Mechanical Engineering, Cornell University, is something like 450, including a considerable number of graduates from other colleges taking, in most cases, advanced work in research and higher engineering; and of the whole list, nearly one-half are selecting the electrical work in specialization, the others dividing between general engineering, steam and naval engineering, and other special lines of work. The upper classmen, to the number of about 200, are all taking work in the mechanical laboratory, which is being considerably extended to meet this large demand. At the end of the year it will have its 200 men assigned to work in strength of materials, and other work of research in that general direction, to engine and boiler testing, and to a great variety of special investigations. The outfit will include an experimental engine of 200 horse power, to be constructed from Mr. Reynolds' designs by the E. P. Allis Co., of Milwaukee; a number of smaller and specially constructed engines and boilers, including the 500 horse power heating plant of the university; collections of steam pumps and injectors; a plant illustrating Hirn's analysis; several air and gas engines, including all the usual types; turbines and rotary pumps; several testing machines of 15,000 to 20,000 pounds capacity, others of 40,000 and 50,000, one of 100,000, one of 200,000, and one of 300,000 pounds limit; with special machines for transverse and torsional testing; some of each kind having autographic registry of very ingenious designs.

A GOOD paste for labels for specimens: Starch, 2 dr.; white sugar, 1 oz.; gum arabic, 2 dr.; water, q. s. Dissolve the gum, add the sugar, and boil until the starch is cooked.

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How Crucibles Are Made.

BY H. C. HOVEY.

The manufacture of fireproof pottery in the United States is a comparatively limited business. There are large regions, and possibly entire States, where not a single crucible is used. There are probably not more than $1,500,000 at present invested in this line of manufacture in America. There are three factories in Philadelphia, two in Pittsburg, two in Jersey City, two in Taunton, Mass., one each in St. Louis, Mo., Mascoutah, Ill., and Bridgeport, Conn. Some of the largest firms carry on numerous branches of business besides, while others, as, for instance, the Bridgeport company, make nothing but crucibles. Limited as this business is, it has features of special interest. For one thing, it is believed that all the large plumbago crucibles used in this country are home-made, the only imported ones being the small "sand crucibles" used by manufacturing jewelers, chemists, and assayers. This is but partly attributable to protection, although there is a duty of 20 per cent (not affected by the McKinley law); for even if admitted free, the foreign goods could not come into competition with those of home manufacture, since the labor item is so much less than the cost of materials, and the latter can be had as cheap here as in Europe.

The ingredients going to make fireproof pottery are as follows: Plumbago, 50 per cent; blue clay, 30 per cent; kaolin, 12 per cent; fire-sand, 8 per cent. These proportions vary with the quality of the materials used, so that the above formula undergoes continual modification, according to the judgment of the mixer.

True economy requires that none but the very best materials should be employed in making a vessel that has to be subjected to the most intense heat. Hence a few words are here in place as to the sources of supply. Only the richest and purest plumbago is serviceable, as any impurities in it would either melt or burn out, and thus spoil the crucible. Probably a chemical analysis would show that hundreds of tons of the plumbago used is from 99 to 99½ per cent pure carbon. In other words, the main ingredient of the plain, homely crucible is identical with the finest diamond in substance, differing from it merely in form. None has yet been found in this country that can stand the prescribed test. Hence what is used is imported directly from Ceylon, where it is mined, excelling in purity and fiber any other known deposit. The principal earth combined with the plumbago is the German blue or pipe clay, from Gross Almerode, in Hesse, where it is found in an elevated plateau, being apparently a lacustrine deposit. Its peculiarity is that vessels made from it can be heated without fusing to from 4,000 to 6,000 degrees Fahr., and can also be plunged cold into the furnace or thrown hot from it without cracking—a treatment that French and American clays will not stand.

Clays found in Missouri were thought, at one time, to meet the requirements, but on trial it was found that they would not answer. Both the clay and the plumbago are brought in sailing vessels at a low rate, and free of duty. A curious fact about the clay is that it is cut in blocks, each of which bears the stamp of the municipality owning the deposit. Once a year they have a public meeting and fix the price for the coming year, after which the trade is free to all the world. The kaolin used in crucible making resembles the china clay used in fine pottery, and is found in various parts of our country, there being large deposits of it in New York, New Jersey, Maryland, South Carolina, Indiana, and elsewhere. That found on Staten Island is preferred. The fire-sand used is nearly pure silica, and in any event must be free from iron. Excellent sand for the purpose is to be had at Gayhead, Martha's Vineyard, and on Long Island, near Glen Cove.

The process of manufacture is seemingly quite simple, as explained to me at the Bridgeport Crucible Works, by the courtesy of the manager, Mr. W. T. Macfarlane. The ingredients named are mechanically combined, the mass is kneaded and spun up into shape, properly annealed—and the crucible is done. But short as this process is, it involves its perplexities. Results are governed by obscure and often elusive causes, and any consequent disappointment may involve serious loss. The continually shifting proportions tax the best trained judgment. For instance, the plumbagoes, while constant chemically, vary exceedingly physically, and the successful manufacturer must vary his combinations accordingly. The clays too must fit the changing character of the plumbago, and the whole crucible must conform to the conditions under which it is to be used. Admirable results may be had in melting one sort of metal in a vessel that would really be worthless for another. A combination containing a tough fibrous plumbago will give a far different result from that to be had with the same mixture where the plumbago, though chemically identical, is crumbly and brittle. The crucible maker of modern times can readily understand the superstition of the old alchemists that originated the very name of his goods, in conformity to which the sign of the crux (the cross) was stamped on the moulded vessel before it was put into the furnace, in order to prevent its being bewitched by the demons of the fire! Following a cask of plumbago from the wharf where it is landed to the grinding room where it is dumped, we see that its contents are made up of bits of mineral of all sizes. These are inspected and assorted. Then they are crushed, and afterward ground to a proper degree of fineness by French buhr stones. The pulverization determines the porosity, on which the ability of the crucible to stand heating and cooling largely depends. If the flour is too fine, the contraction is not taken up in itself as it should be, and the vessel will crack after being used only once or twice. If on the other hand it is too coarse (as occasionally happens), the melted metal leaks out as if run through a sieve. The German clay likewise is crushed and pulverized, after having gone through a preliminary process of drying in dry closets, each holding 20 tons. The different flours and grades are stored in separate bins. Then follows the extremely delicate and important task of mixing the ingredients, which is seen to by the manager himself, who is so very careful in this as to weigh down to a quarter of a pound in a ton and a half of material. The mass next goes to a mixing tub, where it is kneaded by rotating blades till it is homogeneous, after which it is stored in moist blocks in the blank room ready for the wheel.

There is no need of my digressing here to describe the simple mysteries of the potter's art—the most ancient and least modified of all arts. The wheel on which the smaller crucibles are spun is almost the exact counterpart of that known to have been used by the prehistoric Neolithic man. But for larger vessels, intended to hold from 400 to 600 pounds of melted metal, special contrivances have been invented to assist the potter in giving shape to the mass of clay at his disposal. He first kneads it over and cuts it through and through with wires to detect the presence of bits of iron, gravel, or other foreign substances. Having patted the mass into an oblong lump, he next drops it into a prepared mould. This used to be made of plaster of Paris, in which the pot would have to stand for some time before being removed. Of course in a large establishment the number of plaster moulds needed would be great, and would occupy much space for storage. Driscoll's patent wooden mould is now used, lined with loose cloth, so clamped as to be able to be taken away as soon as the pot is shaped, leaving it intact. One mould may thus be kept constantly in service, and far more rapid and satisfactory work is done, because the dough does not need to be so wet as in the old process. After partly drying, the crucibles are pared to a proper finish and placed on shelves in large drying rooms to season for from ten to twenty days. Then they go to the annealing ovens, which are at first very gently heated, but afterward to an intense degree. It occasionally happens that a "green" pot gets by mistake into the oven, and as the moisture is changed into steam, it is rent to fragments with a report like the discharge of a cannon. The sound crucibles, after cooling and due inspection, are suitably packed for shipment. Even after they get into the hands of the brass founders, or others who intend to subject them to a fierce heat, the pots are stacked for supplemental seasoning above muffles in which other work is being done. The best crucibles are expected to stand sixty or seventy rounds for melting purposes. The fragments of those used up in the brass foundries are treated as worthless; but those used in making steel are not injured to such a degree as to prevent their being cleaned from slag and ground over again for use in making a cheaper grade of firepots.

In view of the rapidly increasing demand for all conceivable compounds of zinc, copper, silicon, aluminum, etc., it is evident that the manufacture of first class crucibles will become an industry of constantly growing importance. It is essential to the finest results that the materials of which the crucible is made should not attack nor affect in any disastrous way the metals that are to be melted in it. It is also desirable that the metals should not undergo any degree of chemical absorption by the ingredients of the pot. To some extent this is unavoidable; as in the manufacture of steel, which does absorb a certain amount of carbon from the plumbago. For this reason superiority is claimed for the Sheffield steel, because it is not melted in plumbago vessels. But on the other hand it is asserted that makers of crucible steel make due allowance for this unavoidable absorption of carbon. In addition to its other qualities the crucible should be a free melter, readily absorbing and transmitting heat; for otherwise heats are delayed, furnaces rapidly burned out, and too much fuel consumed in proportion to the results gained.

In conclusion we may sum up the qualities of a perfect crucible in the words of Mr. Macfarlane: "It must combine the highest refractibility with the ability to pass through enormous gradations of heat without warping or cracking; it must be firm enough to stand a high melting heat; it must not injure the metal made in it, nor subject it to loss by leakage through the pores; and it must absorb and transmit heat readily." The only true test is actual use. And as failure in actual use may involve serious and costly consequences, too high an estimate can hardly be put upon the need of skill, experience, and sound judgment in crucible making.

Astronomical Phenomena during the Year 1891.

The principal phenomena predicted for the year 1891 are four eclipses, two of the sun and two of the moon, a transit of Mercury over the sun's disk, and the disappearance and reappearance of Saturn's rings. Of these the last two will excite the most interest.

A total eclipse of the moon, May 23, will be invisible in the United States, but visible generally throughout the western part of the Pacific Ocean, Australia, Asia, Africa, and Europe.

An annular eclipse of the sun, June 6, will be visible in the northern part of Siberia. It will be visible as a partial eclipse in the western part of the United States, in British America, Europe, and Siberia.

A total eclipse of the moon, November 15, will be visible throughout North and South America, Asia, Africa, Europe, and the Atlantic Ocean. It will begin at 3 h. 36 m. and end at 9 h. 3 m. P. M. central time. We expect later to give a chart of the moon's path among the stars during this eclipse, and a list of the stars which will be occulted.

A partial eclipse of the sun, December 1, will be visible only in the southern part of South America and the south polar region.

The transit of Mercury across the sun's disk will take place on May 9, beginning at 5 h. 55 m. and ending at 10:53 P. M. central time. It will be partly visible in the United States and throughout the western part of North and South America and Asia. The whole transit will be visible in Japan, China, Eastern Siberia, Australia, and the Malaysian Islands. It is not likely that any expedition will be sent out for the purpose of obtaining observations of this transit under favorable circumstances, for such observations would be of value only in determining the place of the planet. The solar parallax, for which such great pains have been taken in observing transits of Venus, has, by other means, been determined with much greater accuracy than could be attained from transits of Mercury. There are, however, interesting questions as to the planet's appearance during transit, its atmosphere and motion. No one who has the opportunity to observe this transit should neglect to make all the use possible of it.

Professor G. W. Coakley, of the University of New York, has computed the times of the contacts for several of the observatories of the United States, data which will be found very useful to those wishing to observe the transit.

On September 22 the earth will pass through the plane of Saturn's rings. The rings then, in telescopes of sufficient power to show them, will appear as a fine straight thread of light. From September 22 to October 30 the earth will be above the plane of the rings, while the sun will be below that plane, shining upon the south side of the rings. The rings then should entirely disappear, except the very fine thread of light which comes from the outer edges of rings *A* and *B*. After October 30 the sun will be on the north side of the plane of the rings, so that its light will illuminate the same side of the rings at which we look. Many interesting observations were made at the time of the disappearance of Saturn's rings in 1878, and, although the position of the planet will be very unfavorable, it is to be hoped that many of them will be repeated this year, and accurate data obtained for the solution of the problems connected with the rings. Saturn will be in conjunction with the sun on September 12, so that at the time of the disappearance of the rings it will be very close to the sun and can be observed only very near the horizon.—*Sidereal Messenger.*

Kola.

The kola seeds can be procured in Venezuela. Karsten, in his "Flore de Colombie," describes the plant as growing wild in the moist, hot woods near the southern coast of Venezuela, but different authors suppose it was introduced by African negroes at the same time that it was taken to Martinique. The French have recently introduced the kola to Guadaloupe and Cayenne, where it flourishes in moist lands at or a little above sea level. It begins to yield a crop of fruit in such situations about its fifth year, and later will yield over 100 lb. of seeds annually. I should doubt the germination of seeds procured here, as they have, I presume, been brought from England, and it is impossible to say how long they have been there from Africa. The tree is the *Sterculia acuminata*, or true kola nut. Even in Africa—at Gambia—the greatest difficulty is experienced in keeping the pods from moulding; but if properly packed they would, I should think, be easily propagated by soaking the nuts for a day and night in warm water, or in a weak solution of ammonia.

NICOLAS PIKE.

THE work on the Brooklyn aqueduct described in the SCIENTIFIC AMERICAN of January 3 is being executed by Messrs. Crawford & Valentine, *not* Mapes, Crawford & Valentine, as the firm name was made to read by our printers.

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Miscellaneous Notes.

Forest Park, St. Louis, is one of the finest parks in the world. It contains two square miles, or 1,280 acres, of forest, glade, lake, and river, with twenty miles of roads and walks.

The Bell telephone patent monopoly in England has expired. The patent there was granted for 14 years. Cheap telephones will now prevail in England the same as in Germany, where Bell failed to obtain a patent. In this country, the Bell patent will expire March 7, 1893, having been originally granted March 7, 1876, for a term of 17 years.

The new U. S. protected cruiser Newark on her recent trial, December 22, 1890, developed a speed of 19·6 knots, under forced draught, during four hours' run. This is one of our latest and best cruisers. She is 327 ft. 7 in. extreme length, 49 ft. beam, displacement 4,090 tons, 8,500 to 9,000 h. p. The new English built Argentine protected cruiser 25 de Mayo on her recent trial trip attained a speed of 20·75 knots with natural draught, and 22·43 knots with forced draught. This ship is 325 ft. extreme length, 43 ft. beam, 3,200 tons displacement, 8,500 h. p. natural draught and 13,800 h. p. forced draught. It will be seen from the foregoing that the English built ship is far superior to the Newark in power and steaming qualities. Somehow or other the latest U. S. vessels are always prone to be behind the latest European vessels in those essential qualities, power and speed. Can anybody explain the real reason?

What is the best position for the bridge aboard a war ship? Our naval architects are of opinion that it should be well forward, in some cases, as on the Yorktown and Concord, setting it up over the topgallant forecastle, and on the Baltimore and Philadelphia jamming it still further up into the bows. The British, on the other hand, think the waist or 'midship section the best place for it; holding that a commanding officer should be able to con his ship without facing about. This is a recommendation, surely, but the advantages of having a clear horizon, an unobstructed view ahead, will appeal to the nautical mind. A bridge forward of the mizzen or even between fore and main masts never affords an unbroken view; in maneuvering, or, worst of all, in meeting other craft or working in a narrow channelway, interposing objects, such as masts, yards and stays, seriously incommode and at times obscure the view. In practicing a crew at working ship or guns, a bridge well aft, as in the British method, affords a better opportunity for critical study, and perhaps, as the British designers allege, in the thick of battle gives the commander a better control of his batteries, but for general service, whether in combat, maneuvering or cruising, the forward position would seem to promise the best results.

The Projected Balloon Voyage to the North Pole.

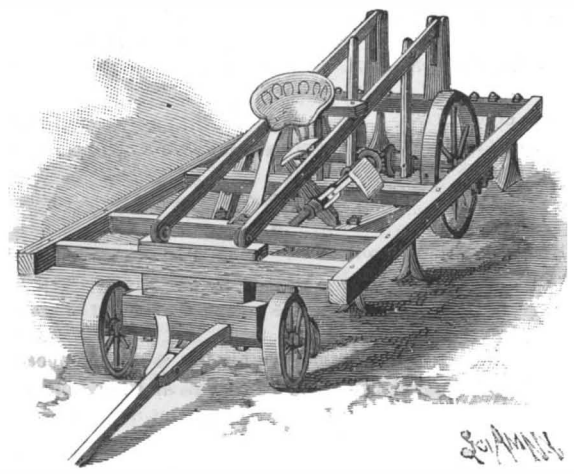
The two daring aeronauts who propose to make a journey to the North Pole, as described and illustrated in the SCIENTIFIC AMERICAN of December 20, 1890, are meeting with many discouragements. The French Society of Aerial Navigation has pronounced unanimously against it. At a recent meeting of the society in Paris, the president, Mr. Mage, editor of *Cosmos*, made an address which was quite disheartening to the projectors of the enterprise. He advised them to make better use of their energy and devotion to science than to attempt to reach the North Pole by balloon. Mr. Mage said it was impossible to believe the gentlemen would succeed. All our information about the prevailing winds in the polar regions indicates that each extremity of the earth's axis is a region of circular wind currents. There is little prospect that the wind would carry balloon travelers to their destination. Then, even in summer, a very low temperature prevails, heavy falls of snow are frequent, and it is difficult to believe a balloon could remain in midair while heavily weighted with snow. Frost upon the ropes and other parts of the rigging would make the management of the balloon extremely difficult, if not impossible. The land or water surface would for days at a time be obscured by heavy mists. The compass would be useless, and the voyagers would have to try to direct their movements by the stars, an art in which balloon travelers are not proficient. Mr. Mage's remarks were endorsed by the entire society.

Mr. Hermite, who, with Mr. Besancon, projected this daring voyage, said in reply that he and his comrade intended next summer to go to Spitzbergen and launch pilot balloons for the purpose of learning all they could at that point of the direction of the prevailing winds. If the result of these experiments is favorable, they will return to France and prepare to make their polar voyage in 1892. If the results are unfavorable, they will renounce the expedition. He did not believe that the difficulties in the way of balloon traveling were so great as the president believed.

Another speaker said that during the summer, at a mean altitude not exceeding 3,500 feet, and the mean temperature during his journey was not less than 40° below the freezing point, and yet his voyage was across the southern part of the island. It was the sheerest folly to suppose a balloon, which has as much rigging as a ship, could successfully be carried across the North Pole.

A COTTON CHOPPER AND CULTIVATOR.

The illustration represents a machine provided with hoes for chopping cotton or other plants, cultivators for working the plants, scrapers to clear the earth in advance of the hoes, and harrow teeth for use when desired. It has been patented by Mr. Thomas E. Anderson, of Jackson, Tenn. Upon the bottom of the main frame are two diagonal side beams, near the forward end of each of which a scraper is adjustably secured. Farther back on each beam are harrow teeth, bifurcated at their lower ends, with the members flaring in opposite directions, these teeth being preferably so attached to the beams as to be vertically adjustable. In the rear end bar of the main frame, at each side of the center, a series of cultivator blades is secured, these blades preferably being of what is known as the "elk's foot" pattern. The rear axle is journaled in vertically adjustable boxes sliding in hangers attached to the main frame, and a bevel gear on this axle meshes with a similar gear on a longitudinal shaft, the bearings of which are capable of vertical movement, and upon this shaft is the chopper. The hub of the chopper has radial arms with longitudinal grooves in which the shanks of the hoe blades are adjustably arranged, one hoe to each radial arm. Located longitudinally over the main frame is a lifting frame having near its rear end downwardly extending hangers which receive the rear axle, and by manipulating an adjusting screw the rear end of the frame is elevated, with the axle and longitudinal shaft, thus regulating the depth of cut of



ANDERSON'S COMBINATION COTTON AND CORN HOE AND CULTIVATOR.

the scrapers and rear cultivators. The depth to which the hoes shall cut is regulated by the adjustment of the hoes upon the arms of their carrying hub. As the machine is drawn forward, the scrapers clear the earth in advance of the hoes, which revolve rapidly to remove the surplus plants, while the cultivators at the rear pass between the remaining plants and throw up earth over their roots. When the hoes are in operation the harrow teeth are preferably adjusted so as not to touch the plants or the ground, these teeth being more especially adapted for use in connection with the rear cultivator teeth only, the longitudinal hoe shaft being then thrown out of gear with the rear driving axle.

New Experiments in Magnetism.

BY A. E. DOLBEAR.

It has long been known that a common sewing needle will float if carefully placed upon a surface of water; also, that if the needle be magnetized it will assume a position in the magnetic meridian. Iron and steel filings will also float, and they can be sprinkled upon the liquid surface nearly as well as upon a solid. If the pole of a magnet be brought near to the floating particles, they will respond to the solicitations of the magnetic field in a very free and easy manner.

Let a strong U-magnet have its poles brought near to the iron filings, and they will at once arrange themselves in the well known forms, the lines being plainly seen. The induction, of course, causes adjacent particles to assume opposite polarities and consequently touch each other when free to move. If, now, the field magnet be removed, the filings will retain their arrangement, and if it be in a vessel large enough to permit the rotation of the whole body, it will swing into the magnetic meridian if it did not happen to be in it at first, thus showing that the *arrangement* constitutes the magnet, and that as a whole it possesses a magnetic field upon which the earth's field can act.

Now bring gently near the floating magnet one pole of a bar magnet. If this be presented to one of the poles of the particles it will be attracted toward it, and the whole body will rotate more or less; but this must be done slowly, else the arrangement of filings will be broken up. The opposite pole will, of course, under similar conditions, exhibit repulsive action, and the whole will swing about.

If, now, the magnetic pole be brought near to the middle of the arranged filings, some of the groups will be more or less disintegrated from the rest, and will rotate upon a vertical axis and quite turn round. The opposite pole presented will cause them to rotate back again. Great numbers of these can be seen to turn thus whenever a pole is thus presented.

This phenomenon is evidently precisely the same in character as that illustrated at length by Ewing in his late investigations into the constitution of magnets, wherein he used small magnetic needles mounted upon pivots. The above experiments can be tried in a saucer of water, but the whole is capable of being projected with the vertical attached to a lantern, and the movements of all sorts seen upon a screen with ease and very little painstaking.—*Electrical Engineer.*

The Sturtevant Rotating Battery for Harbor Defense.

For the defense of harbors where the ground admits of the formation of an artificial island, Thos. L. Sturtevant, of South Framingham, Mass., proposes the following plan:

An island of generally circular form is established which incloses a circular reservoir of water. Protection is afforded the reservoir by inclined armor plates buried under the earth and surrounding it by a protective subterranean cave. Within the reservoir a circular floating battery is established, pivoted or anchored by a central pin driven into the bottom of the reservoir. The battery has a roof like an inverted saucer, and is perforated for heavy guns. The armor plate may be of the heaviest kind, as the displacement may be increased to any desired extent. The roof is extended beyond the sides of the tunnel, so as to cover nearly the entire area of the reservoir. A sluiceway is carried out under the surface of the island to admit water if desired. A valve or gate is provided to prevent its escape. In use the entire battery is rotated by hand or by power, so as to bring its guns to bear on any desired point.

Trial Trip of the Gunboat Concord.

This new steel vessel made a successful trial trip on Long Island Sound, January 13. She is a sister ship to the Yorktown, described in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 687. The trial lasted four hours, during which the engines were required by the contract to develop an average of 3,400 horse power, with a bonus of $100 for each horse power above this number and a corresponding penalty below. The machinery easily fulfilled the requirements, in the opinion of the engineers, and the vessel is thought to have earned a premium of some $16,000.

The engines worked beautifully with no water on the bearings and the throttle wide open all the time. The steam pressure averaged 160 pounds for the four hours. The average number of revolutions of the engines was slightly over 150. The boilers worked well also, keeping a steady pressure of steam all the time, with about two inches of air pressure in the blower ducts. The average speed made was 15·8 knots per hour by log, but allowing for current running against the vessel, the actual speed was computed to be 16·8 knots.

The Concord has the closed ash-pit system of forced draught. She is a twin-screw, coal-protected steel gunboat, with poop and forecastle decks and an open gun deck between; length, 226 feet; mean draught, 14 feet; displacement, 1,700 tons. There are two horizontal triple expansion engines in separate water-tight compartments, one forward of the other. The cylinders have a thirty-inch stroke. The engines are fitted with the Marshall valve gear and piston valves. There are four steel boilers, diameter 9 feet 9 inches, and length 17 feet 9 inches. Each has three corrugated steel furnaces. Grate surface total, 220 square feet. Total weight of machinery, with boilers filled, 331 tons. The propellers are of manganese bronze, three-bladed, and of the modified Griffith type. Diameter, 10½ feet; mean pitch, 12½ feet.

The contract for this ship was made November 15, 1887, with the Quintard Iron Works, and she was to have been completed in eighteen months, but the contractors were subject to delay on account of difficulty in getting material.

When put in commission she will have a battery of six 6-inch breech-loading rifles and eight rapid-fire guns and revolving cannon. She has, besides, eight torpedo-launching tubes. She is rigged as a three-masted schooner, spreading 6,300 square feet of sail, and will have a crew of 150 men.

M. LUDOVIC JAMMES, in the *Revue d'Hygiene*, reports that commercial travelers are offering imitation coffee berries which can be sold so low to dealers as to yield a profit of 100 per cent. These berries are made artificially from vegetable glands and the flour of some cereal. This mixture is placed in a mould and dried. The slit in the false berry is neither so long or deep as in the real berry. The color is well imitated, but the false berry is much harder and cannot be broken with the teeth. These berries are mixed with a small proportion of the true berries before selling.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING.—John La Burt, New York City. With this device the cars will couple automatically, so that it will not be necessary for the brakeman to go between them, while they may be easily uncoupled, the link having a laterally curved coupling arm, and a rearwardly curved arm with a slot engaged by a pin moving vertically in the drawhead, a lever mechanism connected with the pin extending to the top and sides of the car.

Mechanical.

NUT TAPPING MACHINE.—Clarence L. Chapman, Erie, Pa. This invention covers an automatic device for removing the nut blanks singly from the hopper and delivering them regularly in proper position to the tap, which is automatically fed and lifted, and removed from the spindle to dump the threaded nuts, the machine cutting the thread in punched blanks without any manual labor except filling the hopper with blanks.

CARVING MACHINE. — Joseph Rohlmann, St. Joseph, Mo. This is a machine adapted to carve simultaneously a number of blocks after one pattern, there being combined, with the frame carrying the cutters and tracing tool, universal joints supporting the ends of the frame, pivoted brackets supporting the joints, and a counterbalanced lever connected with the free ends of the brackets, a pivoted arm carrying a shaft on which the lever is pivoted, with other novel features.

SPRING MOTOR.—Daniel B. Merry and William M. Shelman, East Las Vegas, New Mexico. This is a device for running sewing machines, etc., and is so constructed that a series of springs, all having connection with one drive shaft, may be wound from one stem, the springs being so arranged that when one spring is unwound it will release the next for unwinding, the idle springs not retarding the movement of the drive shaft.

Miscellaneous.

LAMP BLACK MANUFACTURE.—Robert Dreyer, Halle-on-the-Saale, Prussia, Germany. This is an apparatus for the manufacture, in which a series of closed reservoirs communicating with each other are supplied with a cooling liquid, while a hollow rotary shaft carries burners and scrapers below the reservoir, to produce lamp black, carbon black, etc., from carbureted hydrogen gases or suitable oily or fatty substances, at the same time utilizing the heat generated during the process.

ROTARY GAS SCRUBBER. — William Mooney, North Plainfield, N. J. The scrubbing frames, consisting of segmental and transverse perforated plates, and rods or spindles, are carried by wheels revolving in a tank supplied with water, whereby the frames will be kept wet, and will mechanically remove from the gas passed through them any tarry matters, ammonia and carbonic acid remaining in the gas being taken up by the water.

WATER GAUGE.—Ira A. Fuller, Pepin, Wis. This is a device designed to give notice of the rise of water in the hold of a barge or ship, and is made with a float in a vertical case having an attached scale which appears at a window, there being also an electric bell and battery whose circuit is closed by the rising of the float.

DRAWING INSTRUMENT. — George A. Brown, Park City, Utah. This instrument has a fixed base plate on which a T-square is held for longitudinal movement, a protractor being detachably connected to the blade and having a longitudinal movement on it, with other novel features, making a convenient drawing instrument which can be readily adapted for architectural or surveyors' uses.

WIRE REEL. — George E. Dixon, Beacon, Iowa. This is a combined reel and stretcher, light and durable, and so made that the reel will be locked when rotation in a certain direction has ceased, preventing slack or unwinding, and making a serviceable device for the construction and repair of wire fences, equally adapted for barbed or smooth wire.

SELF-CLOSING CAN.—Stephen O. Myers, Mount Vernon, N. Y. By this invention a spring-pressed valve is adapted to close the neck of the can from the inside, the construction being simple and durable, and the can being designed to hold ether, chloroform and other liquids, which will thus be prevented from spilling, no matter in what condition the can is left.

PIANO PEDAL AND GUARD.—Walther T. Stirnenberg, New York City. This pedal is made with laterally projecting shoulders, practically concealing the slot through which the pedal passes, while the guard plate combined therewith protects the polished face of the case and is designed to give a more than ordinarily attractive appearance to the front of the instrument.

VENETIAN BLIND.—Charles Niss, Jr., Milwaukee, Wis. The supporting frame or receptacle for the slatted blind is provided by this invention with novel devices for supporting and adjusting the slats, either to elevate or depress them, or to rock each slat edgewise when the blind is in lowered adjustment.

FIRE ESCAPE.—Samuel M. Stevenson, Bastrop, La. This escape is made with a double-walled fireproof car, a transverse shaft in which has a friction drum and flanged pulleys, in combination with fireproof ropes and a brake mechanism, etc., whereby attachment may be made to an upper window of a structure, and its occupants safely and speedily lowered to the ground when other avenues of escape have been cut off.

CLOTHES PIN. — Charles A. Ostrom, Hans H. Thiellesen, and Samuel C. Wampler, Custer City, South Dakota. This is a spring wire clamp, the ends of a spring wire being formed into jaws having sides inclined toward each other, a slide engaging the sides to open and close the jaws, and a spring catch locking the slide in place, the device being exceedingly simple, strong and efficient.

WASTE PIPE. — Thomas Keely, Memphis, Tenn. This is an improved attachment for refrigerators in which a drip pipe projects downward into a waste pipe proper, but is not arranged in contact with it, there being combined with the outer pipe an inner drip pipe having an inwardly curved point terminating in the center line of the pipe.

WATER CLOSET CISTERN.—Charles G. Zeilman, Albany, N. Y. This invention provides a cistern designed to be very sensitive and positive in operation, to prevent all leakage and overflow, a pipe sliding on a stationary overflow pipe to form an extension thereof, while a float is supported on the pipe and a siphon held on the float to charge and empty the siphon, the construction being simple and durable.

BACK BAND.—Willie L. Johnson, Lake City, Miss. This is an improvement in back bands for plow harness, and provides a combination of buckles and snap hooks and movable connections whereby the height of the traces may be quickly adjusted and the draught so regulated as to increase or diminish the depth of the furrow cut by the plow.

STIRRUP.—George A. Kerns, Victoria, Texas. This stirrup consists of a struck-up metallic body portion with outwardly projecting flanges, leather covering and securing pieces, and other novel features, designed to afford a stirrup of great strength and lightness, and which will also be ornamental and inexpensive to manufacture.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN
BUILDING EDITION.

JANUARY NUMBER.—(No. 63.)

TABLE OF CONTENTS.

1. Handsome colored plate of an elegant residence on Riverside Avenue, New York City. Cost $60,000 complete. Floor plans, two perspective elevations, etc. Mr. Frank Freeman, New York, architect.
2. Plate in colors showing an attractive cottage at Maplewood, Chicago. Estimated cost $3,000. Perspective view and two floor plans.
3. A cottage at Rutherford, N. J., erected at a cost of $6,000 complete. Perspective elevation, floor plans, etc.
4. An elegant residence at Chestnut, Hill, Pa., recently erected for Mr. Alfred C. Rex. Cost $30,000 complete. Floor plans, perspective elevation, etc.
5. Sketch and floor plans of a residence at Stockton, Cal. Estimated cost $10,000.
6. Cottage at Englewood, Chicago. Perspective view and floor plans. Cost $4,200.
7. Residence on Powelton Avenue, Philadelphia, Pa. Cost $30,000 complete. Architect Thos. P. Lonsdale, Philadelphia. Floor plans, perspective elevation, etc.
8. A cottage at Jackson Park, Chicago. Estimated cost $4,000. Floor plans, perspective elevation, etc.
9. Cottage on Munroe Avenue, Chicago. Two floor plans and perspective view. Cost $900.
10. Residence at Wayne, Pa., from plans prepared by W. L. Price, architect, Philadelphia. Cost $7,000 complete. Floor plans, perspective view, etc.
11. An attractive country church of moderate size recently erected at Glen Ridge, N. J. Estimated cost about $15,000. Perspective view and floor plan.
12. Cottage at Lakeview, Chicago. Floor plans and perspective view. Cost $3,000.
13. A stable combining both beauty and convenience, erected for Mr. A. C. Rex, at Chestnut Hill, Pa. Cost $1,800. Plans and perspective.
14. A cottage at Austin, Chicago, Ill. Cost $4,200. Two floor plans and photographic view.
15. Sketches of park entrance lodges.
16. Engraving of the Woman's Temperance Temple, Chicago, Ill., as it will appear when finished. Estimated cost of the Temple $1,100,000.
17. View of Whitworth Memorial Hospital.
18. Miscellaneous contents: The marble industry.—Lighting streets of London.—Mahogany ties and marble bridges.—Staining floors.—The Peruvian temple of Pachacamac.—How to catch contracts.—Black birch.—Some of the merits.—Improve your property.—The SCIENTIFIC AMERICAN a help to builders.—An improved article for plastering, tiling, and cement work, illustrated.—The Sinclair double rocker, illustrated.—An improved veneer press, illustrated.—Our last year's volume.—The Albany Venetian blinds, illustrated.—A convenience for hospitals, families, etc., illustrated.—The education of customers.—The Buffalo hot blast heating system, illustrated. — The "Willer" sliding blinds, illustrated.—Mueller's water pressure regulator.—Artistic wall decorations.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(2728) J. F. W. asks: If there is a substance, as elastic and equally as good otherwise, as India rubber. A. No. The substitutes treated of in our SUPPLEMENT, Bolas' lectures on India rubber, etc., are but poor apologies for the true article.

(2729) T. A. M. asks: Could a hollow airtight float for a steam trap be practically made, thereby doing away with the hollow spindle, opening to the outside, which is the common form? Would the condensation of the inclosed air reduce the buoyancy of the float, or necessitate a much heavier metal to withstand the steam pressure? Would it be practical to fill the float with some buoyant gas, under pressure enough to equalize that of the steam? What would be a good battery for electroplating small articles, such as keys, etc.? A. Hollow ball floats are now used for steam traps. You require no gas or other substance in them. Only make them heavy enough and perfectly tight. The difficulty in making them tight is the reason that they are not generally used. Any of the batteries described and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 157, 158, 159, will answer for electroplating, 10 cents each mailed.

(2730) R. T. B. asks: Will you please give me a recipe for making moulds to work plaster ornaments, known in the trade as gelatine? Its proportions in bulk, weight or measure. A. Good glue soaked and swelled. Pour off excess of water. Mix, glycerine six times the weight of the dry glue used. Heat and evaporate water sufficient to make the mixture of the proper consistence.

(2731) R. says: I cannot wear flannel drawers without experiencing the most intolerable itching, chiefly along the front of the leg between the ankle and the knee, but more or less over the whole leg. It commences at about the end of the first ten days after putting on the flannel, and continues for a month after it is taken off, even though left off at the end of the first two weeks of wear. The skin shows no sign of irritation, save what follows from scratching. The intense itching makes it absolutely impossible to abstain from scratching. This is caused by the best quality of Dr. Jaeger's natural wool, as well as by ordinary flannel and cotton, half of each. As to red flannel, it is worse, if anything could be more disagreeable. I could as well wear the shirt of Nessus. The flannel shirt is not so bad, though it does cause an itching of the forearm. Be kind enough to answer through your Notes and Queries: 1. What causes this effect? A. The flannel, and it is a personal idiosyncrasy. 2. What will prevent it, the flannel still being worn? A. Nothing; perhaps by silk or linen underwear interposed between wool and skin. 3. What will allay the itching within any reasonable time? A. Leaving off flannel or wool, or according to suggestion in No. 2. 4. If it cannot be prevented, flannel being worn, what substitute, not subject to the same objection, for the flannel can be worn in cold weather? A. Silk, or following No. 2.

(2732) P. C. asks: 1. Which is the most convenient shade to be given to the walls of a photographic dark room? A. An orange red color. 2. How should the glasses of its window be coated, and which is the most expeditious way to do so? A. Insert between two plain glass windows fine sheets of oiled post office paper. This makes a safe light. 3. Would you give the receipt for a good gold paint to be applied with a brush to iron or wood? A. Use bronze powder, applied with copal varnish. As a permanent mixed paint use linseed oil and japan as vehicle.

(2733) G. N. asks: 1. Can a boiler explode with plenty of water, and what would cause it to explode? A. A boiler may explode by over-pressure or by becoming too weak at some point for the pressure. 2. Which explosion would have the greater force—a boiler with low water and a high pressure of steam or a boiler with high water and high pressure of steam? A. Undue pressure, by the sticking of the safety valve, has often been fatal. A full boiler is more disastrous than one with low water, when it explodes, owing to the steam liberated from the larger body of water. 3. How much coal does the City of Paris consume on a trip across the Atlantic? A. The great steamers consume 200 to 350 tons of coal for 24 hours.

(2734) S. F. S. asks: 1. Is it not possible to telephone as far as to telegraph? Why not? A. On account of the escape along the line of the secondary current used in telephony. Also on account of induction and earth currents and time required for static charge and discharge of line. 2. If copper wires instead of platinum were used in incandescent lamps, would the expansion of the wire be too great or not great enough to correspond with the expansion of the glass bulb? A. For 1° in a length of 100 feet glass expands 0·000574 inch, platinum 0·000571, and copper between 0° and 212° 0·00115 for each degree.

(2735) F. G. asks: 1. Is there any danger of an explosion when nitric and sulphuric acids are mixed together in equal parts without being reduced to the temperature that they usually are when used for nitroglycerine? A. No. 2. If the glycerine was added suddenly, would it not cause an instantaneous explosion? A. Probably not, as mixture would be required. 3. If it would cause an instantaneous explosion, would the effect be as great as if it had been manufactured into nitroglycerine? A. No. 4. Why is there more silver in a standard dollar than there is in two half dollars? A. The subsidiary coin is only a legal tender for amounts up to and less than $10. Its value is statutory for these cases. The dollar is legal tender for unlimited amounts.

(2736) E. asks: 1. What is the difference, if any, between ordinary coal gas and that produced from gasoline, and what are the elements and signs of each? A. Gasoline gas is of far higher specific gravity (0·800 or more) than coal gas (0·450 to 0·500). It contains more carbon and differs in odor. 2. How can one produce chemically the different constituents of coal gas, separately, and then combine them to produce a gas equal or like coal gas? A. This is hardly practicable on the large scale. The chemical manuals tell how to prepare hydrogen marsh gas, olefiant gas, and carbonic oxide. These can be mixed so as to closely approximate to coal gas. 3. Would the act or operation of manufacturing them separately and combining be attended with more danger than the handling of coal gas? A. Yes; it would multiply operations, and there would be much more danger of explosions, etc.

(2737) A Subscriber asks: Would you have the kindness to publish the recipe for the painless extraction of teeth? A. The best known method is the use of nitrous oxide or "laughing gas." It has been used in hundreds of thousands of cases, and no deaths have occurred.

(2738) J. H. asks for a good cement to fasten square gold and silver wire inlaid in wood. A. Try marine glue or bicycle tire cement. Do not use common glue, as it will never adhere.

(2739) S. E. L. writes: I have a meerschaum pipe; the stem is broken off; please write me what I can use to mend it. A. Dissolve caseine in water glass. You may mix with it some powdered meerschaum or even carbonate of magnesium. Prepare the caseine by curdling skimmed milk and filtering out the precipitate and afterward washing it thoroughly. Also see next query.

(2740) H. C. C. asks: 1. What is the best cement (or how to make it) for mending and repairing broken glass, porcelain, crockery ware, etc., that will be (near) water and fire proof, or that will hold together strong and lasting? A. One-third of a pint of milk is curdled by adding vinegar. The whey is taken and the white of an egg is stirred into it. Finely divided quicklime is added and the mass is thoroughly mixed with a knife or spatula and applied to the surfaces. After drying in air it is heated over a stove or in a rather cool oven. 2. How to bend on shape an amber tube such as the stem or mouth piece of a smoking or tobacco pipe. A. Slight heating softens amber, but it is dangerous to attempt to bend it unless you have had experience. 3. How best to clean a meerschaum and brier root pipe. A. For cleaning a meerschaum pipe see queries No. 2364 and 2474. For a wooden pipe simply scrape, buff, and sandpaper it. 4. What is the best or good book of practical receipts for mechanic, for mending and repairing household articles, etc.? A. The "Techno-Chemical Receipt Book," $2; "Workshop Receipts," 4 vols., $8; "Dick's Encyclopedia," $5.

(2741) W. L. G. asks: How can plaster of Paris casts be cleaned, without being affected as they are by water? A. There is no good way short of rubbing with ground pumice or very fine sand paper. Various methods of rendering them impervious are given in the receipt books, a polish being imparted that enables them to be satisfactorily cleaned. Otherwise the best plan is to keep dust off, as once it has obtained a hold it adheres tenaciously.

(2742) N. A. asks how much wire is required to wind sewing machine motor as described in SUPPLEMENT, No. 759; how much for field, No. 16 double C C, and for armature No. 20 double C C magnet wire? A. About 3½ pounds of No. 16 wire for the field magnet and ¾ pound No. 20 for the armature.

(2743) G. B. J. asks one or more of the best formulas or processes of waterproofing compressed

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paper so that it will not be affected by either hot or cold water. A. Parchmentizing by treatment in a relatively large quantity of a mixture of 2 volumes sulphuric acid with 1 volume water is the best. This may be applied to single sheets afterward compressed into pasteboard. After immersion in acid it must be washed off with water and dilute ammonia. The requirement of resistance to hot water excludes paraffin and varnishes generally from the list of substances which might answer your requirements.

(2744) S. P. asks: What will put a gloss finish on oil cloth that won't crack when rolled up? A. We can only suggest the best quality of varnish applied in successive thin coats. Possibly celluloid varnish would answer. Japanning would be excellent if the goods would stand the heat.

(2745) O. A. R. writes: I have a meerschaum pipe which when warm I have been rubbing with white wax to make it color. I have rubbed in too much; can you tell me how to draw the wax out? A. Keep on smoking the pipe and wipe off the wax as it exudes from the pores. The trouble will thus be rectified.

(2746) C. W. C.—The best information we have places the annual consumption of borax in this country at about 2,000 tons.

(2747) W. J. R. asks: Will you kindly tell me how to make a good sticking paste for sticking stamps and labels on beer kegs. We experience a great deal of trouble in cold weather by stamps blowing off. A colorless paste would be preferred. A. If rye flour paste will not answer, try freshly made solution of gum tragacanth, or try one of the pastes given in the SCIENTIFIC AMERICAN, November 1, 1890, page 281, and October 11, 1890, page 227.

(2748) I. T. E. asks how to make a cheap flour paste, such as is used by paper bag manufacturers on machinery. A. Rye flour paste, made by boiling rye flour with water, is the best of the simple pastes, and is used by bag makers. For other formulas see SCIENTIFIC AMERICAN, as in preceding query.

(2749) C. W. H. asks (1) for a recipe for making a chemical ink eraser. A. Mix equal parts of oxalic and tartaric or citric acids in powder. When to be used, dissolve a little in water. It is poisonous. 2. A recipe for making mucilage in stick form. A. Mouth glue is what you refer to. Soak good glue in water for a day or more until softened. Pour off excess of water and melt the glue. For each part of glue used add one-half part of sugar; mix and pour into moulds.

(2750) W. H. E.: How can I make a thin skin that I have, tough and strong? A. Massage or rub the skin thoroughly with flesh brush. Bathe frequently with cold water. Once or twice daily sponge with solution of coarse salt in alcohol or water.

(2751) W. E. B. asks: What is the best material to make the covering of a balloon that will hold hydrogen without leaking? A. India rubber cloth or sheet is the only tissue that can be recommended, and it is too heavy and expensive. The gas is almost impossible to retain. For regular balloon varnish, its preparation, etc., we refer you to our SUPPLEMENT, No. 726.

(2752) G. H. W. asks for dimensions of induction coil for telephone transmitter, viz., size and amount of wire in primary and secondary coils. A. The Bell Telephone Company's coils are wound thus: Primary, ½ ohm, No. 18 to 24 wire; secondary, 80 ohms, No. 36 wire. This gives for No. 18 wire a length of 75 feet, for No. 36 wire a length of 186 feet. Other lengths can be found in electric resistance tables.

(2753) C. L. S. asks for the best polish to use on pianos and organs, etc., something easily applied, that will give a good gloss. A. Apply olive oil and water mixed on the palm of the hand. No severer treatment than this should be necessary. Rottenstone and oil may be applied with a piece of fine cloth in very bad cases, to be followed by the hand rubbing described.

(2754) J. M. F. asks for a good receipt for making a cement to put paper on iron pulleys. A. Use fresh and thick solution of gum tragacanth.

(2755) W. M. C. asks: Wishing to freeze ice for my own family use, I write to ask how I can freeze it in boxes, what kind of boxes, and how I can get it out of them? A. Water can be frozen by freezing mixtures, such as 1 part nitrate of ammonium and 2 to 3 parts water, but on a small scale it is expensive and unsatisfactory. Most of the salt can be recovered by evaporation. The freezing mixture can be applied in an ice cream freezer. The ice can be removed from the boxes by pouring hot water over them while inverted. Use tin boxes. The freezing mixture must be stirred vigorously.

(2756) J. I. C. asks: Of what is the red material on the edge of tablets composed? A. Glue 50 parts, glycerine 9 parts, water enough. Color to suit with aniline or cochineal. Soak glue in water alone, then dissolve, and finally add glycerin.

(2757) A. C. W. writes: To settle a dispute, and one which is liable to bankrupt somebody unless nipped in the bud, I would ask, as I agreed to foot it, if ice forms underneath or on top, *i. e.*, after say 3 inches is formed, does it continue to form underneath or does it form on the top? A. It forms underneath, sometimes snow and slush add to its thickness by freezing on its surface after becoming solidified by rain or thawing.

(2758) W. H. M. writes: I am troubled with an over production of fatty matter from the sebaceous glands, and my nose keeps shiny and greasy all the time. Can you kindly suggest something to dry these glands up? A. It would not be advisable to dry the glands up, but the secretion may be diminished and the unpleasantness removed by the use of Castile or ivory (toilet) soap applied thoroughly with nail brush about three times a week, or oftener. Sponge the nose gently with ether on the alternate days. Or you may use a saturated solution of boric acid and alcohol applied with soft linen rag three or four times a day.

(2759) C. O. D. asks: Will you be kind enough to tell me, if you can, how to reduce paraffine wax so that it can be worked with the hands? I wish to make plaster of Paris moulds in wax for confectionery uses. I have used glycerine, also lard, but have had no success yet. I know it can be reduced and worked in that manner, but don't know how to do it. A. Mix the paraffin with olive oil, melting all together.

(2760) J. R. H. asks: 1. What is the pressure per square inch at a depth of 1,000 feet below the surface of the water, and what is the rule for finding the same? Also is it true that a weight that will sink a man to a depth of 50 feet will sink him to any depth. If the pressure on the inside of a cannon at the time it is fired is 60,000 pounds per square inch, what is the pressure at the time the ball leaves the cannon or gun, say it is 60 feet long, as, for instance, a pneumatic gun now in use? Could you please give me the rule for finding the pressure of powder or dynamite when it is exploded? A. Multiply the feet in depth by 0·433 for the pressure, which at 1,000 feet is 433 pounds per square inch. Any body that will sink 50 feet will go to the bottom at any depth. The pressure in a gun is relieved at the instant that the ball passes the mouth. It is the relief that makes the report. The pressure in a pneumatic gun varies from 100 to 700 pounds per square inch as the charge moves along. The pressure in the best ordnance is from 40,000 to 50,000 pounds per square inch. The rule is derived from the power of the powder or dynamite, of which the expansive test is the principal factor. See article "Projectiles," in Chambers' Mathematics, $1.50 mailed.

(2761) H. T. B. asks: Will you please give a formula for magnesium powder, such as is used on the stage? A.

Chlorate of potash..... .. ..3 parts.
Perchlorate of potash.....3 "
Magnesium powder.....4 "

(2762) W. S. F. asks how to make a shoe dressing for ladies' shoes. A. We can supply you with "Workshop Receipts," 4th series, $2, which contains numerous receipts for blackings. Also consult query No. 1704.

(2763) G. V. A. asks: 1. Does heat applied to a casting with a hole in it increase or diminish the size of the hole? For instance: I saw an engineer undertake to remove a crank pin from a large cast crank by heating the whole to almost a red heat and then cool off the iron about the pin before undertaking to remove it. His philosophy was that the cooling contracted the iron away from the pin, thus loosening it. A. The expansion or contraction of a hole in a mass of iron depends very much upon the relative thickness of the iron in proportion to the size of the hole. If uniformly heated, the hole and metal expand together by heat, while in a large mass of metal heated, the hole will enlarge by cooling the metal immediately around it while the outside remains hot. This is on the principle that the metal is somewhat elastic and yields to the expansion strain of the heated outer mass. In the case that you state it was of course necessary to cool the crank pin as much as possible. 2. When a boiler is worked with a high pressure and shut down for the night, everything being tight, what sort of a vacuum will be produced in the cooling down? Can it in any way become dangerous? Will the water in the boiler show its natural or true level while there is a vacuum? A. The cooling of boilers that are tight often produces a partial vacuum, which is of no harm, as a perfect vacuum is never over 15 pounds to a square inch, and the vacuum in boilers seldom reaches 10 pounds, for which they are amply strong. The case is different in the copper boilers of our kitchens, which are very thin and have been known to collapse by vacuum. The vacuum does not affect the water gauge.

(2764) G. A. K. asks whether fluor spar is found in ore, or not, and the color of the same. I have found a certain ore which I have reason to believe contains something of that mineral. A. Fluor spar is found as a natural deposit in great quantities and in various colors. It may be transparent and crystalline or massive and opaque.

(2765) M. McI. asks: What is the simplest method of making rubber stamps? A. By pressing a sheet of mixed rubber against a plaster matrix while heated to about the temperature of boiling water. A small press is used. By increasing the heat, the rubber being still in press, the curing is effected. The matrix may be made from plaster of Paris by casting it upon the face of oiled type. We also refer you to query 2696.

(2766) J. W. F. asks (1) how to dissolve crude or virgin rubber. What I want is to soften the rubber so I can work it into a round ball and remain pliable to collect waste gold around the finisher's bench. A. Chloroform, turpentine or benzol are recommended as solvents. You can soften the gum by low heat, about that of boiling water, and press it into shape. Coat your mould, etc., with talc powder. The best substance of all for this purpose is what is known as "burned rubber," sold for artists' use in removing crayon marks. For full particulars of manipulation of India rubber, burned rubber, etc., we refer you to "Rubber Hand Stamps and the Manipulation of Rubber," which when published we will supply by mail for $1. 2. Also how to water silk. A. Silk is watered by hot calendering between engraved surfaces.

(2767) W. H. G. writes: I had an argument the other day with a friend of mine, and he said if you could dig a hole through the center of the earth to the antipodes, and then drop a stone down from the top, it would hang in the middle with nothing to hold it there; another one put in on the other side would come up to meet it, and both would hang there without anything to hold them up. Will you please give me your opinion on this subject? A. The stone would naturally seek the sides of the hole. If it remained effectively equidistant, it would act as your friend describes, after oscillating up and down for a while. The second stone under the same conditions would act as described.

(2768) J. W. B. asks: 1. Has muriatic or sulphuric acid greater effect in dissolving wrought iron? A. There is little or no difference between them. 2. Will sirup of 24° Baume density fall over a vertical row of horizontal tubes as rapidly as water in 160° heat and 21 inches vacuum? A. It will not, as it will continually thicken and concentrate in its descent. 3. Can you give any preparation with which to paint wrought iron, which will withstand 220° heat and muriatic acid? A. Nothing reliable can be given. 4. Can you also name a preparation which will prevent iron from rusting and which will run off when heated to 190°? A. Try paraffine wax, made more fusible if necessary by olive oil.

(2769) J. B. S. writes: Would you have the kindness to give me a simple rule, and an illustration of the following: How many superficial feet are there in a marble slab ⅞ inch thick and 18 by 18 inches? A. The superficial feet in one face are given by multiplying the width and length together, both expressed in inches or in feet. If in inches, the product is divided by 144 to reduce to superficial feet. If to be reduced to feet one inch thick, multiply by seven and divide by eight. Thus 18 by 18 = 2¼ superficial feet. This reduces to $1\frac{1}{32}$ superficial feet one inch thick. If the entire superficies, both sides and edges, is meant, we must take double the area of a single face to give both sides and add the product of ⅞ by 72 inches (the perimeter) = 63 square inches or $\frac{7}{16}$ superficial foot. The total therefore is $2\frac{1}{4} + 2\frac{3}{4} + \frac{7}{16} = 4\frac{15}{16}$ superficial feet.

(2770) G. A. G. writes: We had a call for some extract of smoke to put on meat instead of smoking it. Do you know of any such extract? A. Crude pyroligneous acid comes the nearest to your requirements. Nothing can supplant the smoking process for real efficacy.

(2771) J. H. M. asks: What chemical change, if any, takes place in the atmosphere of a closed room heated by a red hot stove? A. It is believed that carbon monoxide gas, which is poisonous, can pass through red hot iron. There is some doubt, however, as to how far the action may go, and as to whether it may be enough to be injurious or not.

(2772) P. B. writes: I find that a plunge battery, or rather a chromic acid battery, of very large current can be constructed with the carbon cup of the Laclede battery, using for zinc a zinc of the Bunsen battery, pint size. The zinc is to be bent out so as to set in the end of the jar, and a channel cut into the carbon cup to allow the zinc connection to pass out without touching. The bending must be done before amalgamation. I do not know the amperage of a cell thus constructed, but it is quite large, for one cell will heat a short piece of platinum wire, such as goes in lamps, almost white hot. It has a very good life, and with small zincs will, I think, maintain its initial current for five or six hours, which is doing very well, considering that each cell holds only a quart of solution. I have been experimenting by using iron in place of zinc in plunge batteries. It appears to give almost as good an electromotive force as zinc, and I believe can be used with much stronger solutions, and does not heat like zinc when unamalgamated. It is certainly much cheaper. The iron I found best adapted to that use, of any I used, was the largest size of iron wire nails, or wire rods. Should any of your correspondents experiment in this direction or find out the amperage of the cell mentioned, I, and I am sure others, would be glad to hear from them. I desire to ask you how the white surface caused by dilute sulphuric acid falling on colored marble can be removed. A. By repolishing by means of powdered pumice stone followed by putty powder.

NEW BOOKS AND PUBLICATIONS.

THE LIFE OF JOHN ERICSSON. By William Conant Church. Illustrated. 2 vols. New York: Charles Scribner's Sons. Pp. xii, 303; x, 357. Price $6.

In these two books the complete biography of Ericsson is given by one selected by the great engineer as his biographer. Whatever popular renown has been attained by the more public achievements of his busy life, many of the most interesting and characteristic features of John Ericsson are unknown to the public. He was so particular in his work, and so mindful of his reputation, that he hesitated to divulge much that he did which was in itself of the highest merit. All through the two volumes instances of his skill and ingenuity in engineering are met with. It is refreshing to read of his way of meeting the conservatism of old-time prejudices which so often sought to thwart him. It is an excellent lesson for the inventor of to-day when told that he is striving after the unattainable. But the moral effect of the lifework of Ericsson and some few others has been felt in this direction, and people have learned to be more cautious than hitherto in pronouncing things to be impossible of execution. We have already in our columns given *resumes* of the work of Ericsson. We are exceedingly glad to find his full biography so handsomely and adequately presented to the public in book form. His views on mathematics are sometimes evidenced strikingly. He held that the ordinary mathematician had no reasoning power, or he would not be driven to the use of symbols unintelligible to others. He wrote a letter giving a short method for determining the thickness of iron plates, ending with the note, "A great mathematician would cover half a dozen sheets with figures to solve the above problem." His absolute reliance on his drawings appears when he rejected the use of measurements of partially completed engines having keyways cut and all arranged by the drawing only. The account of the caloric steamship Ericsson, with her giant cylinders 14 feet in diameter, of her stormy voyage to Washington, of the perfection of the machinery, which proved unable to impart the necessary speed, of her sinking off Sandy Hook, with a view of the vessel at sea, reads like a novel. The plan was abandoned, to Ericsson's most bitter disappointment. Column after column could be filled with the accounts of the inventor and of his work. The book itself must be recurred to by those interested in one of the most picturesque lives of the present day.

A handsome calendar for 1891 has been issued by Messrs. Styles & Cash, printers and stationers, No. 77 Eighth Avenue, New York. It has attractive views in colors of the old colonial days in New York, and a large plain dial, with prominent figures and pointer, for each month.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

January 13, 1891,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid, dioxynaphthaline-mono-sulphonic, M. Ulrich 444,679
Alarm. See Water alarm.
Animal trap, H. H. May 444,760
Automatic camera, Fisher & McFarlane 444,488
Axle and bolster, vehicle, L. P. Friestedt 444,590
Axle lubricator, J. Sharkey 444,582
Axle, wagon, L. P. Friestedt 444,591
Axles, hub attaching device for vehicle, H. F. Bock 444,517
Axles, rolls for manufacturing car, D. L. Evans 444,746
Bag. See Paper bag.
Band and tire setting machine, J. H. Samuels 444,547
Band cutter and feeder, O. Anderson 444,478
Beams and girders, lengthening metallic, P. H. Jackson 444,579
Beams, lengthening metallic, P. H. Jackson 444,578
Bed bottom, spring, L. B. Houston 444,610
Beer cooling apparatus, D. L. Holden 444,593
Bell, magneto, W. R. Patterson 444,600
Bellows, S. T. Culp 444,744
Bicycle, W. R. O'Neill 444,639
Binder, temporary, J. Dornbirer 444,695
Bit. See Bridle bit.
Bit for horses, C. P. Gregory 444,425
Blankets, etc., machine for finishing, A. F. Bornot 444,888
Boiler pedestal, A. P. Creque 444,692
Boiler stand or support, A. P. Creque 444,693
Boilers, cleaning, J. M. Boyer 444,481
Bolt and rivet cutter, J. Helwig 444,635
Bolts, etc., machine for heading, C. S. Seaton 444,460
Book, bank account, W. Thomson 444,583
Books, method of and mechanism for making blank, E. N. Martineau 444,699
Boot, M. F. Jarden 444,708
Boot or shoe scraper, C. Spahmer 444,716
Box. See Journal box. Letter box. Stuffing box.
Brace. See Wagon spring brace.
Bracket. See Lamp bracket. Umbrella bracket.
Brake shoe, C. W. Roepper 444,508
Bricks, tiles, etc., apparatus for moulding patterns on hollow, R. M. Downie 444,628
Bridle bit, R. Emerson 444,629
Bullets, manufacturing, A. Weed 444,474
Calcimine, compound for, G. A. Casselman 444,776
Camera. See Automatic camera. Photographic camera.
Can. Shipping can.
Cane and camp stool, combined, A. Schneider 444,621
Car controlling device, electric, E. M. Bentley 444,479
Car coupling, E. N. Gifford 444,697
Car coupling, C. W. Hunt 444,594
Car coupling, C. P. Jacobs 444,493
Car coupling implement, T. J. Thorp 444,548
Car, electric railway, E. M. Bentley 444,480
Car, electric railway, L. A. McCarthy 444,539
Car pusher, C. A. Kimball 444,443
Car replacer, A. G. McKinney 444,783
Car, sleeping, M. H. Troop, Jr 444,468
Carbon for arc lights, B. B. Ward 444,471
Carding machinery, E. V. Bates 444,720
Carpet fastener, stair, W. G. Collins 444,589
Carpet or oil cloth stretcher, A. R. Anderson 444,415
Carpet stretcher, D. H. McFalls 444,903
Carriage, baby, F. S. Briggs 444,519
Carriages, wheel locking device for baby, Graham & McDonald 444,432
Carrier. See Cycle luggage carrier.
Cart, road, S. J. McDonald 444,456
Cellulose films, producing, J. Williams 444,515
Centerboard for vessels, F. M. Moore 444,501
Chairs, sofas, etc., attachment for, J. Zapp 444,719
Chisel, mortising, A. P. Lanterman 444,596
Chuck, drill, N. E. Austin 444,586
Chute, coal and grain, T. W. Emery 444,745
Cigar blank, H. N. Anderson 444,624
Cigar machine, J. E. Rickards 444,768
Clamp. See Extension clamp.
Clamp, P. Brown 444,484
Clock, independent electric, E. G. Hammer 444,433
Clock pinion, A. Bannatyne 444,684
Clocks, electric hand setting mechanism for, Bradley & Packer 444,482
Clothes pin, H. Tirrill 444,603
Clutch, friction, J. L. Hayden 444,436
Coach, combined sleeping and day, A. A. Brandenburg 444,741
Coffee mill, E. H. & C. Morgan 444,798
Coffee pot, G. A. Williams 444,572
Coiling apparatus, rod, H. Roberts 444,653
Coiling metal rods, apparatus for, H. Roberts 444,652
Coiling wire rods, appa. for, F. H. Daniels 444,550, 444,551
Collar and tie holder, shirt, W. H. Barbour 444,516
Collar fastener, horse, P. P. Armour 444,625
Compressor mechanism, La Casse & Wile 444,755
Conduit inspector, J. L. Blackwell 444,687
Cooler. See Liquid cooler.
Copy holder, T. K. S. McGriff 444,612
Coupling. See Car coupling. Hose coupling. Pipe coupling. Whiffletree coupling.
Cow tail holder, E. G. Farnham 444,428
Crate, G. W. Worden 444,657
Crate, poultry, R. G. Thomasson 444,561
Crucible furnace, J. F. Barker 444,658
Cultivator, A. H. Tripp 444,800
Currier's knife, H. B. Bryant 444,721
Cuspidors, device for cleaning, J. McPherson 444,710
Cutter. See Band cutter. Bolt and rivet cutter. Wire cutter.
Cutting machines, carrier attachment for, E. W. Ross 444,459
Cycle luggage carrier, T. G. Allen *et al* 444,642
Dental plate, R. J. Wenker 444,622
Desk, J. J. Collier 444,663
Die. See Interchangeable die.
Distilling wood, apparatus for, A. Koch 444,704
Door check, J. Shinn 444,730
Door hanger, Flanders & Smith 444,725
Duplex engine, Worthington & Caldwell 444,543
Dust and cinder protector, Z. J. Goodwin 444,749
Dye, blue, Mohler & Mayer 444,538
Dynamo brush, A. S. Cook 444,794
Dynamometer for locomotives, R. H. Innes 444,611
Electric circuits, controlling currents upon, J. Hopkinson 444,553
Electric currents, phase indicator for alternating, C. S. Bradley 444,791
Electric elevator, Otis & Smith 444,640
Electric indicator, J. Hopkinson 444,552
Electric light support, A. Dawes 444,424
Electric machine regulator, dynamo, R. E. Ball 444,587
Electric machinery, dynamo, J. B. Entz 444,486
Electric motor, W. A. Anthony 444,416
Electric wire conduit, A. P. Wright 444,477
Electrical sporting indicator, S. D. Mott 444,452, 444,453
Elevator. See Electric elevator.
Elevator and endless carrier, P. Newcomer 444,540
Elevator shifting ropes, grip for, S. C. Swett 444,556
Engine. See Duplex engine. Jordan engine. Pumping engine.
Engines, cut-off mechanism for steam, E. J. Chapin 444,773
Envelope, H. A. J. Rieckert 444,651
Exercising apparatus, G. S. Sanborn 444,674
Exhibitor for shade fabrics, wall papers, etc., cabinet, B. Handforth 444,701
Extension clamp, J. J. Tanner 444,510
Extractor. See Spike extractor.
Fabric turfing implement, Lewis & Genereily 444,545
Faucet, self-closing, H. A. Walker 444,514
Feed grinder, C. A. Claypool 444,472
Feed rack, J. F. Fitzgerald 444,577
Fence, A. L. Kitselman 444,753
Fence building machine, picket, E. E. Witter 444,726
Fence machine, wire-and-slat, J. M. Orcutt 444,559
Fence making machine, W. H. Jenkins 444,752
Fence post, E. Minnick 444,781
Fence posts, etc., metallic socket for, C. A. Lounsberry 444,497
Field glasses, compass attachment for, E. G. King 444,795
Filter, etc., F. Breyer 444,483
Filter, E. M. Knight 444,754
Filter, W. W. Whiddit 444,623
Filtering apparatus, H. Stockheim 444,733
Fire escape, H. C. Moir 444,670
Fire escape, W. H. Wyland 444,788

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Fire escape ladder, E. Eder 444,607
Fish hook, J. Stretch 444,656
Flume or conduit, M. H. Laybourn 444,496
Folding gate, W. R. Pitt 444,765
Frame. See Spectacle frame.
Furnace. See Crucible furnace.
Furnace, H. Petersen 444,671
Furnace regulator, E. J. Colby 444,691
Furniture, school, O. S. Garretson 444,630
Gas lighter, electric, T. W. Lane 444,706
Gas producers, poke pole for, G. W. Goetz 444,631
Gate. See Folding gate.
Glass, decorating, G. W. Martin 444,797
Glass, manufacturing, R. S. Pease 444,560
Globe, J. Lyman 444,796
Grain meter, Michener & Varns 444,709
Grain scouring machine, W. Morgan 444,763
Gun, breech-loading, Blachon & Mimard 444,574
Gun with pneumatically operated magazines, magazine, R. Dinsmore 444,666
Hame hook, W. J. Dankworth 444,664
Hanger. See Door hanger.
Harness, device for fastening pad screws in, E. E. Reed 444,711
Harness, martingale attachment for, S. E. Mathews 444,648
Harness tree, adjustable, W. O. Miller 444,762
Harrow, disk, G. M. Clark 444,662
Harvester, corn, D. W. Blaine 444,723
Harvester, cotton, F. Van Dorn 444,801
Hay press, F. Donald 444,667
Hay sling, W. Louden 444,546
Hay tedder, G. Crews 444,423
Heater. See Hot water and steam heater. Sad iron heater.
Heating apparatus, device for automatically regulating combustion in hot water and hot air, J. C. F. Atsatt (r) 11,139
Hides, bating, N. Wilson 444,771
Hinge, Krause & Kramer 444,445
Hinge, adjustable, W. McCarthy 444,455
Hoisting machinery, B. W. Grist 444,592
Holder. See Collar and tie holder. Copy holder. Cow tail holder. Leggin holder. Stub holder. Sewing machine attachment holder. Ticket holder.
Hook. See Fish hook. Hame hook. Snap hook. Whiffletree hook.
Horses, independent check for, C. R. Taylor 444,677
Horses, spreader for gaiting, J. R. Phelps 444,570
Hose coupling, J. C. Shull 444,676
Hose nozzle, D. Roach 444,712
Hot water and steam heater, E. D. Van Stone 444,802
House. See Portable house.
Ice and refrigerating machine, D. L. Holden 444,532
Ice cream freezer, Bessonette & King 444,790
Inclining table, C. L. Hartsfeld 444,634
Indicator. See Electric indicator. Electrical sporting indicator. Potential indicator. Racing indicator.
Insect destroyer, wheeled, A. D. Tyrrel 444,786
Interchangeable die, H. B. Anable 444,682
Iron. See Sad iron.
Ironing machine, G. Binder 444,722
Irrigating apparatus, D. W. Copeland 444,564
Ivory, manufacturing artificial, A. & S. De Pont 444,775
Jewelry, L. J. Roehr 444,673
Jordan engine for grinding pulp, E. W. Barton 444,644
Journal box, W. S. Sharpneck 444,509
Knife. See Currier's knife.
Knife sharpener, A. Duedden 444,522
Knob or handle shank, J. L. Gallagher 444,524
Knob shank, C. M. Burgess 444,557
Ladder, fire, H. Goosmann 444,632
Lamp bracket, electric, T. C. Smith 444,466
Lamp, electric arc, B. B. Ward 444,472, 444,473
Lamp, safety, J. B. Harris *et al* 444,435
Lamp shade tripod, A. W. Paull 444,650
Lamp socket, incandescent, G. R. Lean 444,567
Lamps, leading-in wire for incandescent electric, T. A. Edison 444,530
Lamps, wick raising mechanism for, B. P. Luce 444,598
Lasting machine, M. Brock 444,792
Lathe, J. L. Bogert 444,544
Lathe, J. B. Preston 444,799
Lathe, turning, J. L. Simmons 444,465
Lathe, wood turning, P. Newman 444,457
Leggin holder, A. Steiner 444,655
Leggin, waterproof, Groat & Van Vleck 444,489
Letter box, J. T. Lenman 444,638
Letter box, street door, D. K. Byler 444,520
Level, plumb, J. T. Lambdin 444,705
Lifter. See Pan lifter.
Lightning arrester, E. Thomson 444,678
Liquid cooler, J. Klein 444,558
Lock. See Till lock.
Locomotive cab seat, E. M. Stannard 444,654
Locomotive, electric, Waddell & Entz 444,512
Locomotives, rail cleaning and lubricating attachment for, H. T. Currie 444,694
Loom, H. Wyman 444,789
Looms, pitman connection for, E. Wright 444,738
Lubricating compound, W. Brinck 444,626
Lubricator. See Axle lubricator.
Massage kneader, electric magnetic, D. & C. Lichenstadt 444,597
Measuring instrument, electric, E. Weston 444,805
Measuring instrument, electrical, E. Weston 444,804
Meats, apparatus for extracting salt from, G. F. Meyer 444,500
Mechanical movement, A. M. Leslie 444,757
Medicine, remedy for corns, etc., A. Robidoux 444,601
Metallic or mineral bearing substances, centrifugally treating particles of, O. B. Peck 444,614
Metallic or mineral bearing substances, machinery for centrifugally treating particles of, O. B. Peck 444,618
Metallic or mineral bearing substances of different degrees of specific gravity, machinery for centrifugally treating particles of, O. B. Peck, 444,615 to 444,617, 444,619
Metallic or mineral bearing substances of different specific gravity, apparatus for separating particles of, O. B. Peck 444,613
Meter. See Grain meter.
Mill. See Coffee mill.
Mining machine, coal, C. H. Wolford 444,476
Molasses mixer, W. N. Villavaso 444,470
Moulding apparatus, D. Carlin 444,588
Motor. See Electric motor.
Mower, lawn, J. E. Ash 444,643
Mower, lawn, E. N. Fox 444,608
Musical instruments, sound board for, A. Springer 444,770
Musical instruments, tone modulator for, A. H. Loebs 444,448
Newspaper vending apparatus, B. Mossler 444,502
Nipper or wire cutter, J. P. Nessle 444,764
Oil, means for storing and handling petroleum, L. C. Snell 444,731
Ore concentrator, F. C. L. Sergeant 444,785
Packing device, J. Park, Jr 444,784
Padlock, G. W. Lucas 444,449
Paint, anti-fouling, N. B. Dennys 444,665
Paint distributer, Huttenlocher & Ullmer 444,440
Pan lid, frying or other, C. Hartley 444,702
Pan lifter, hot, M. B. Penfield 444,504
Paper bag, W. D. Smith 444,527
Paper bag machine, E. E. Claussen 444,727
Paper bag machine, W. A. Lorenz 444,728
Paper bag machine, Lorenz & Claussen 444,729
Paper weight, L. B. Martin 444,647
Pencil sharpener, Gorton & Bedell 444,431
Pessary, E. W. Wagner 444,513
Photographic apparatus, L. Lumiere 444,535
Photographic apparatus, coin controlled automatic, E. G. Fisher 444,487
Photographic apparatus for holding and developing dry plates, G. H. Cobb 444,422
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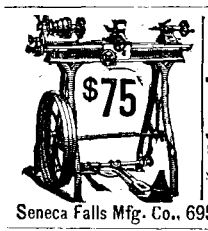

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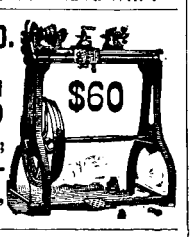

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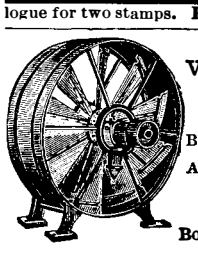

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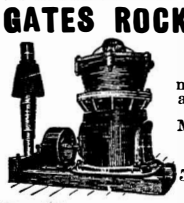

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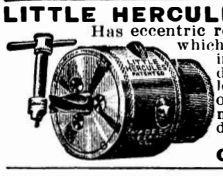

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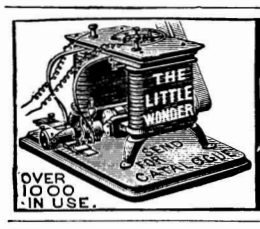

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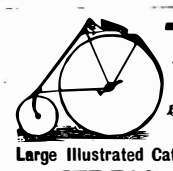

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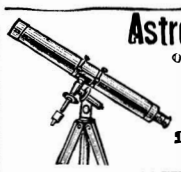

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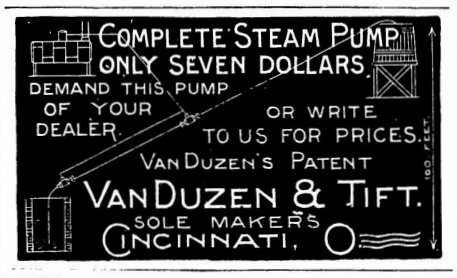
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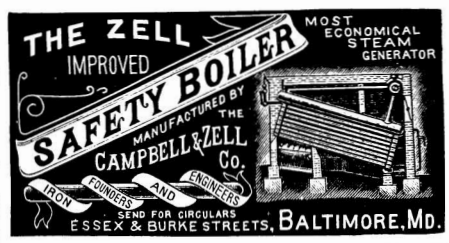
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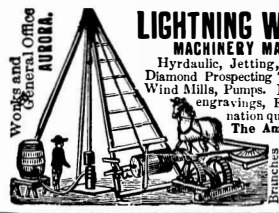

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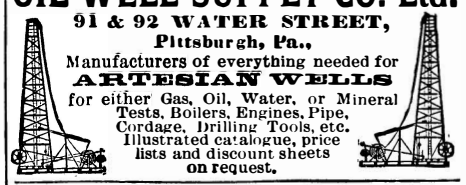

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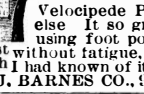
2nd  **MACHINERY** Lists Sent.
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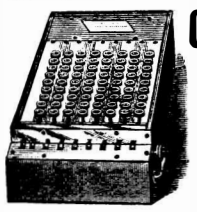

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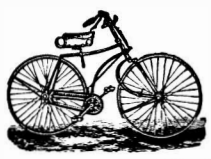

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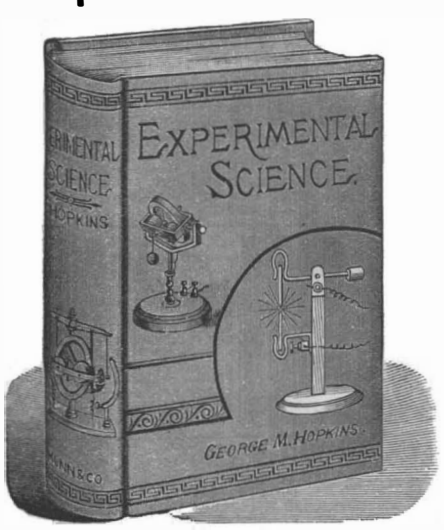

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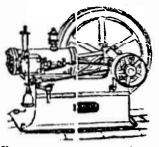

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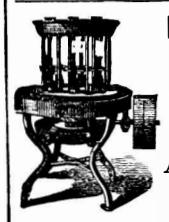

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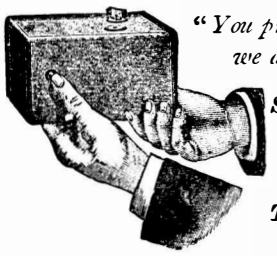

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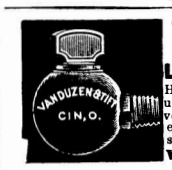

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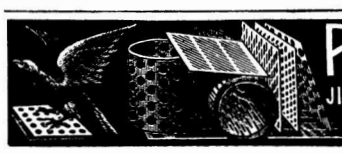

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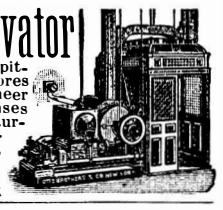

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